AMERICAN ENGINEER AND RAILROAD JOURNAL.

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CONTENTS.

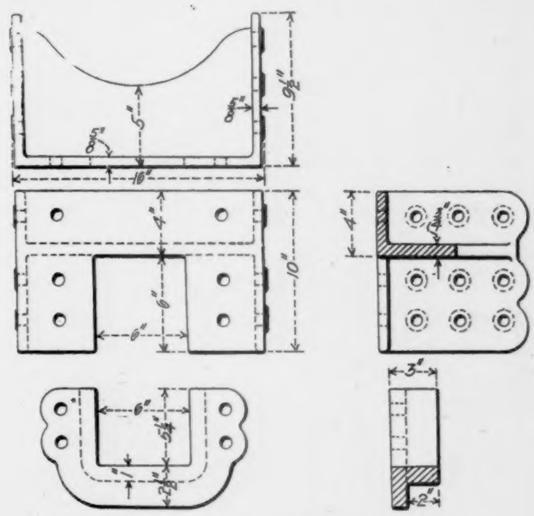
VANDERBILT STEEL TANK CAR, 12,000 GALLONS CAPACITY.

Designed by Cornelius Vanderbilt for the Equitable Land and Oil Company.

The American Steel Foundry Co., of St. Louis, Mo., are building 500 tank cars of 12,000 gals. capacity for the Equitable Land and Oil Company, from designs prepared by Cornelius Vanderbilt. The cars are to be used for transporting oil from the Texas oil fields to St. Louis, and are the largest capacity tank cars in use.

The aim in the design of the car was to dispense with the heavy and unnecessary flat-car arrangement for supporting the tank. The only necessity for an underframing in a tank car, provided the tank is of sufficient diameter and thickness of shell to resist the bending moment due to the load, is to safely resist the shocks and strains to which all freight cars are subject. By providing two 12-in. I-beams, extending the entire length of the tank, in contact with the tank itself, this required stiffness is secured. The points of actual support are the two transoms, which are made of cast steel. The strain in the metal in the tank due to this form of construction is in no case in excess of 1,800 lbs. per square inch. Between the transoms are two cast-steel spacers, securely riveted to the two I-beams, similarly to the transoms, while four straps, each provided with two turnbuckles, serve to preserve contact between the tank and the I-beam. These I-beams also serve to protect the tank from tendency to shear at the points of support. The tank is made secure against longitudinal movement by blocks of wood at either end, braced by a steel casting. The end sill is made of ⅜-in. steel plate reinforced between the draft sills by a steel casting, which compensates for the metal cut away for the coupler shank, and also acts as a buffer casting to receive the shocks from the coupler horn. The drawbar carry iron is made of cast-steel and is secured to the sill plate and the buffer casting by four ⅞-in. bolts. These bolts are in shear. The casting is made of angle section, giving a deep flange extending vertically below the coupler shank.

Another departure from precedent is the location of the running board. In the old type of tank car the space between the tank and the outside of the flat car provides means of passing from car to car, and in some more recent designs the running boards have been placed along the side of the tank nearly level with its center line. It will be noted that this design places the running board on the top of the tank with a guard rail at one side. In this way are secured the best means of communication between cars, making it as easy for a man to pass from a tank car to a box car as from one box car to another. This is a feature that at once commends the design to practical railroad men. The hand brake wheel is also located above the top of the tank, as in most designs of box cars. Malleable iron brackets, riveted to the tank, support the running board. These brackets also support the hand-rail columns. On the right side, at each end of the car, is a ladder secured at the top end to the running board and resting on the end sill platform below. The draft sills are 10-in. channels extending from the end sills to the transoms, where they are securely riveted to a ¾-in. flange on the casting. This transom takes all the shocks from the draft sills, distributing them to the 12-in. I-beams, so that none of the buffing or pulling strains are transmitted through the tank. The draft gear proper is of the twin-spring type, with cast-steel sill plates. The tank is made of ¼-in. plate, with double riveted lap joints, and ⅝-in. rivets. The heads are made of ⅜-in. plates. The dome is



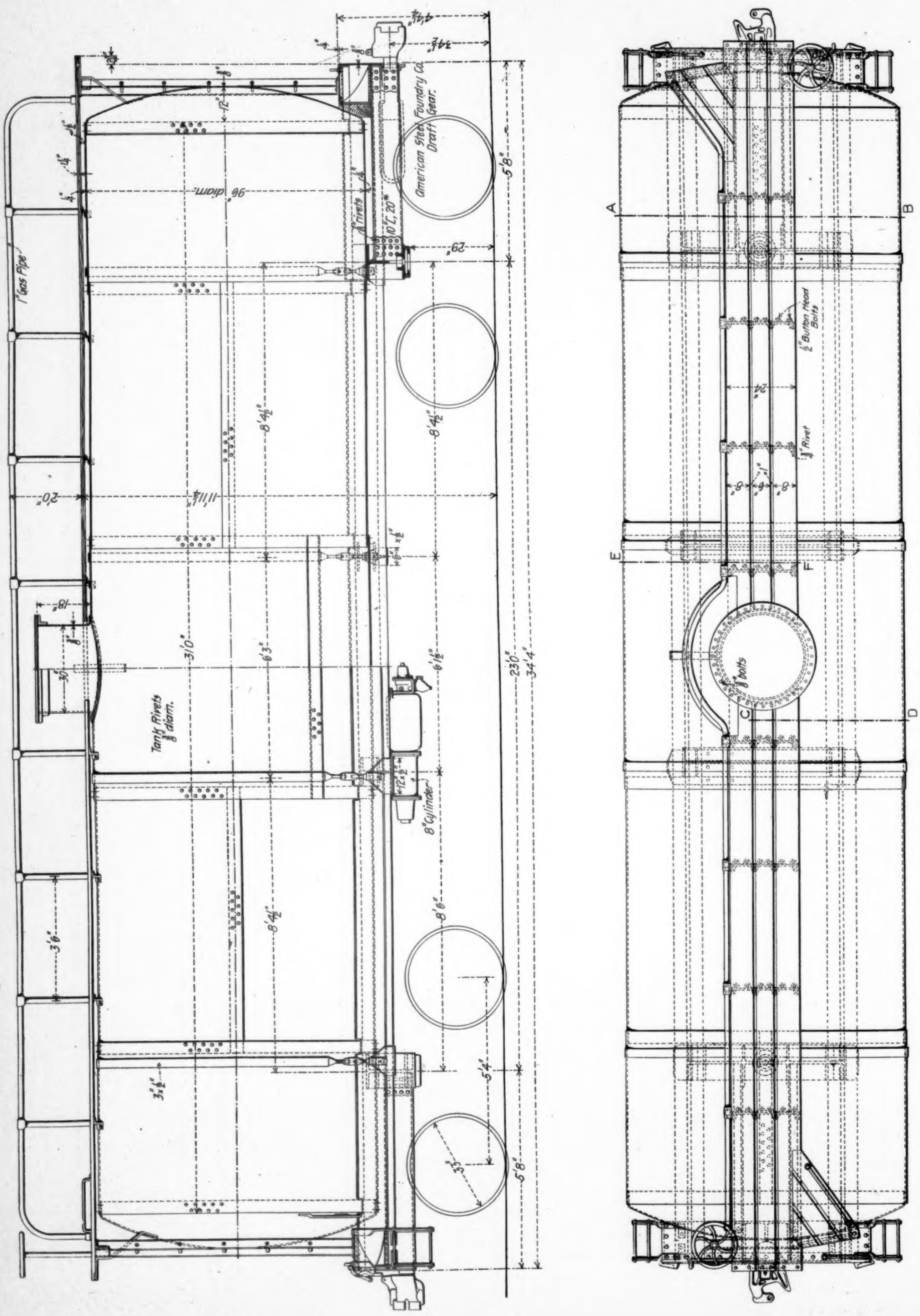
Drawbar Support.

flanged at the bottom and held to the tank by one row of rivets. The trucks are the American Steel Foundry Company standard, with cast-steel bolsters. In the drawings of the details it is apparent that unusual care has been taken in the combination of simplicity and strength. Among them may be noticed the large diameter of the center plate and its combination with the bolster casting. Its large area will increase the stability of the car and tend to relieve the side bearings.

A very important factor in the design of tank cars, as well as freight cars of all other types, is the dead weight to be hauled, and in this design this feature is made prominent. The dead weight is even less than the dead weight of any tank cars of 8,000 gals. capacity that we have seen, whether of wood or steel underframing. The additional capacity, the simplicity of construction and the strength due to this method of construction should make this design a strong competitor in future construction.

The advent of 500 of these cars will help to relieve the famine in oil cars in Texas and will undoubtedly lead to further orders for this large capacity equipment.

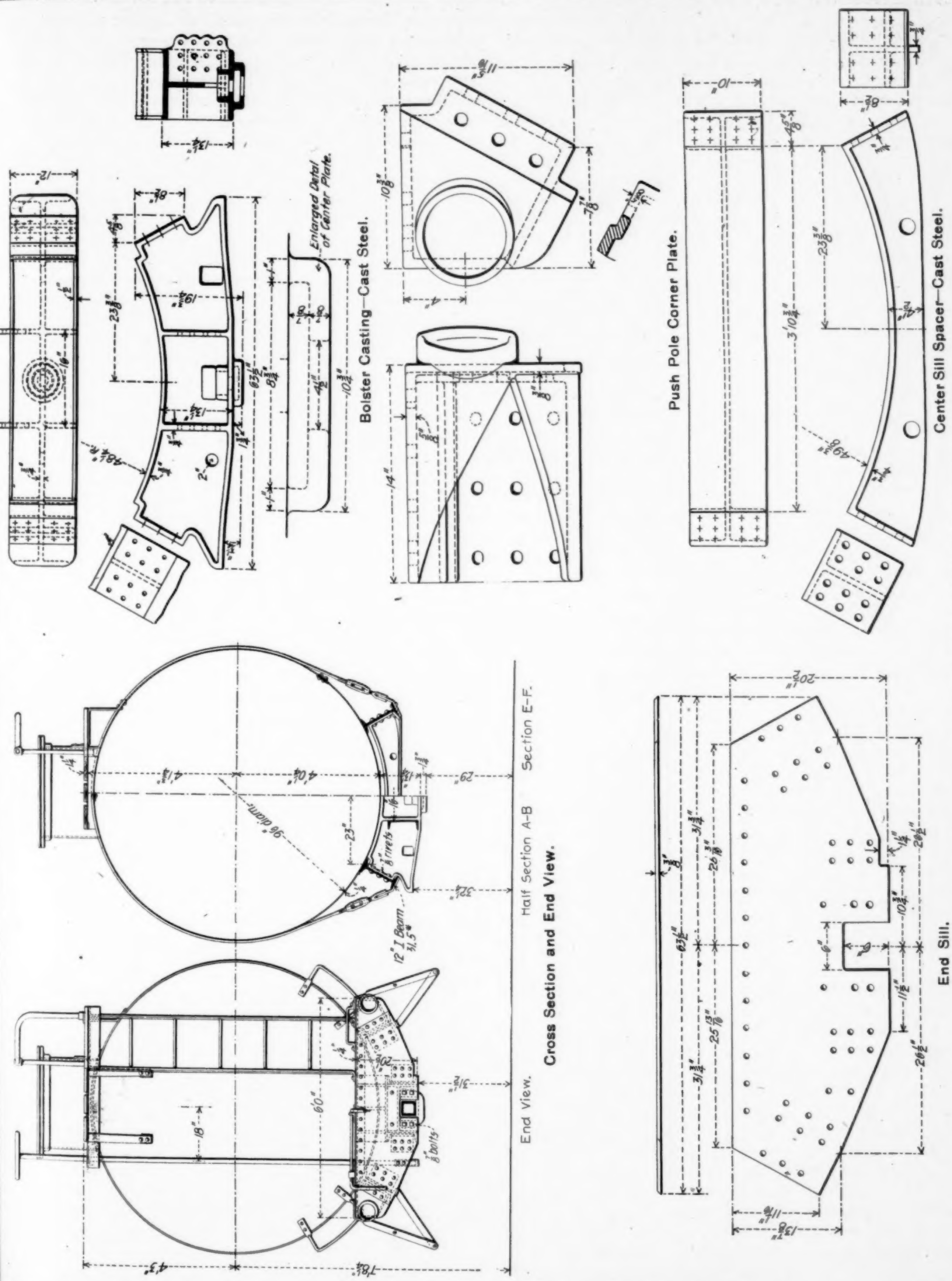
The special equipment includes Missouri Pacific M. C. B. couplers, trucks and bolsters by the American Steel Foundry Company, twin spring draft gear, Damascus brake beams, and



Built by AMERICAN STEEL FOUNDRY CO.

VANDERBILT STEEL TANK CAR—12,000 GALLONS CAPACITY.

Designed by CORNELIUS VANDERBILT.



VANDERBILT STEEL TANK CAR—12,000 GALLONS CAPACITY

Built by AMERICAN STEEL FOUNDRY COMPANY.

Designed by CORNELIUS VANDERBILT.

Westinghouse air brakes. The most important dimensions of the car are as follows:

Vanderbilt Steel Tank Car.

Capacity of tank	12,000 gals.
Inside diameter of tank	8 ft.
Length of tank, outside heads	32 ft. ¾ in.
Length over end sills	34 ft. 4 ins.
Length over running boards	34 ft. 9½ ins.
Height, top of rail to top of guard rail	13 ft.
Height, top of rail to top of brake wheel	13 ft. 11¼ ins.
Height, top of rail to top of running board	11 ft. 11¼ ins.
Height, top of rail to top of end sill platform	4 ft. 4¼ ins.
Width of end sill	6 ft.
Truck centers	23 ft.
Running board, yellow pine	1¼ in.
Guard rail, gas pipe	1 in.

AMERICAN ENGINEER TESTS.

Locomotive Draft Appliances.

IV.

THE THEORIES TO BE INVESTIGATED.*

A Research By H. H. Vaughan.

Member A. S. M. E.

This preliminary discussion does not and cannot explain everything; there are an immense number of contradictory and curious facts in the Hanover tests, but it does explain a great many; for instance in many cases the area of the top of the stack and the nozzle distance seem to be the only dimensions that count, especially in cylindrical stacks. In these cases the action of the jet is practically the same and will continue so up to a point where the entire jet cannot flow out on account of insufficient velocity. At this point the jet suddenly spreads (see Fig. 2 of Master Mechanics' Association report) and this spreading means the conversion of the kinetic energy of the jet into an increase in its pressure and the cessation of entraining action, and from that point on the edges are simply pushed out. There is certainly a sudden spreading close to the top of the stack in all cases when the kinetic energy of the jet is transformed into an increase of pressure. This is the reason for the rapid spread of the jet as measured in the Hanover tests, where successive lengths of stacks were added to measure the jet at different heights, thus getting altogether erroneous results, as in each case the jet was spreading as it lost its velocity in developing atmospheric pressure.

There are a few practical points we can all see at any time that appear to me to support the entraining theory as against the inducing. In an engine smoking badly the smoke certainly passes out over almost the entire area of the stack and is certainly as dense in the center of the jet as at its edges. If the smokebox gases were expelled on account of their induced motion this would not be the case. In an engine exhausting slowly with a rather large stack the center portions of the jet can be seen to move with high velocity, while around the edges are fluffy eddies of steam that do not accelerate with each exhaust and simply curl around and pass up slowly. There is simply not sufficient effluent velocity in the edges of a jet in such a case to allow the air to pass out at the rate we know it is passing into the firebox. In an engine with too large a stack (a very usual combination), while the steam at the edges of the visible jet is not moving at a comparatively slow velocity, no steam or smoke is visible for an inch and sometimes 1½ inches from the rim of the stack. This is not the area through which gases are passing out. It is the space through which air is flowing in on account of the edges of the jet and the small ring of induced gases surrounding it not having sufficient velocity to pass out of the stack or to keep the air outside from flowing in, which is very nearly the same thing. When the exhausts are slow enough to allow the front end vacuum to vary it is evident that such an action as this would account for the relative efficiency of long and short front ends, which may therefore depend to a large extent upon the stack and nozzle. Some little practical experimenting would support this view.

There is evidently some benefit in a stack tapered from 1 in 6 to 1 in 12. I do not see the reason for this, unless it be that when a jet is entraining air and gradually transferring the energy from the center of the jet to its edges, it, for a physical reason dependent on the rate of diffusion of air into steam, expands at an angle of 1 in 6, and that continued expansion at this angle allows the velocity to be evened up, as it were, over the entire area of the jet. Confining the jet in a cylindrical stack after it has expanded to nearly fill the stack prevents this averaging process, and the center of the jet discharges at a high velocity while the edges have lost too much. Upon the entraining theory it is also possible to explain the divergence between the Hanover and the Master Mechanics' Association results. The heavier the gas that is entrained by the jet, the more rapidly it will spread and lose its velocity, so that it would be expected that a greater nozzle distance would be required to give the best results with hot air than with cold, which is the difference actually found. This entraining theory can easily be tested without great expense, and whether correct or not I feel that some such explanation can be found which is capable of being applied quantitatively with a fair amount of accuracy.

As the object of this discussion is chiefly to specify what work requires to be done, I would suggest that I believe that as far as the plain stack and nozzle is concerned, a series of experiments on the steam jet should be carried out to define exactly some such theory as I have outlined. These tests should be made with cold air, and in them the velocity and pressure of the jet at various axial and nozzle distances should be carefully found, as well as the same data for the surrounding air. The temperature and composition should also be obtained if possible. No locomotive is needed for this work, but a large jet of steam is required. After the laws affecting such a jet are fairly well established, sufficient experiments should be repeated with air of a high temperature, to enable the difference in its behavior to be clearly understood with sufficient accuracy for practical purposes. By the aid of such experiments, which need not be expensive or elaborate, I believe we should be in a position to adapt the Hanover experiments to locomotive conditions, and could then avail ourselves of that splendid series of experiments, and the relations of the plain stack and nozzle would be then known with sufficient accuracy to obviate the necessity of any further tests on a locomotive testing plant. If this proposition is accepted as true the balance sheet of what we know and what we want to know on this subject stands about as follows:

BALANCE SHEET.

(1) Efficiency of stacks in various forms in combination with nozzles of any size at variable nozzle distances, with various volumes of air.	To be established with sufficient accuracy by adaptation of Hanover tests to locomotive conditions.
(2) Efficiency of various forms of nozzles.	Established by Master Mechanics' Association experiments.
(3) Efficiency of various heights of bridge walls.	Established by Master Mechanics' Association experiments.
(4) Efficiency of various areas of choke of exhaust pipe.	Established by Master Mechanics' Association experiments.
(5) Relative efficiency of single and double nozzles.	Established by Master Mechanics' Association experiments.
(6) Efficiency of various stacks and nozzles in combination with a petticoat pipe.	Experimented on by Master Mechanics' Association committee, but results not determinate.
(7) Efficiency of various lengths of front ends.	Experimented on by Master Mechanics' Association committee, but results not determinate.
(8) Efficiency of various forms of baffle plates or diaphragms.	No recognized experiments.

Evidently any experiments that are made should be directed to the last three items, and of these only one, the first, presents any serious difficulty. The best length of front end can be tested with ease, and all that is necessary is to provide conditions that are entirely constant in every other way, so as to avoid any question as to this length being the only variable.

Tests, should, however, be made, I believe, with several sizes of stacks, as it is possible that a down draft or rather a partial return of exhausted gases to the front end may occur, and if this is the explanation for some statements that have been made about the drop in efficiency caused by long front ends, it would also be advisable to run a series of tests under actual conditions at several speeds, in each case trying, say three lengths and carefully noting the vacuum and velocity of the gases at several points.

The efficiency, or perhaps it would be preferable to term it the obstruction, caused by the baffle plate, can, I think, be safely stated to be dependent on two variables, the distance of this plate from the flue sheet and the area through which the gases are compelled to flow; a series of experiments with sheets at three different distances, which sheets could be raised or lowered to positions for which this area can be ascertained, would

* Typographical errors in previous article. Page 368, ninth line, below table, for "stuff" read "steam." Page 369, fourth line, second column, read "$A_1 V_1 = A_2 V$".

define the increase in smokebox vacuum rendered necessary by this appliance, and determine its best position, so far as permitted by practical reasons.

The investigation of the action of the petticoat pipe will require more extensive tests than either of the above, and while a fairly accurate theory of the action of the steam jet with a plain stack might define that when a petticoat pipe is used, I do not believe that there is much chance of such a result and consider that it must be treated separately. Without doubt, however, the velocity, pressure, and if possible, the temperature and composition of the jet and its surrounding gases should be carefully taken, so that not only are results obtained, but the action may be sufficiently understood to enable such results to be applied to larger or smaller engines. The tests should preferably be conducted in a similar manner to the Master Mechanics' Association test of 1896, except that I should recommend that a steady jet be employed in place of the exhaust from an engine in motion. The flow of steam should be perfectly steady, and means should be provided for accurately measuring the pressure in the exhaust pipe. In order to reduce as much as possible the time and expense of these tests, I should recommend that both petticoat pipes and stacks be so arranged that they can be lengthened or shortened when the test is in progress. This can be easily done in the case of the straight stacks, for the taper stack sections can be arranged so as to be readily removable. At least four stacks should be tested, 14 and 16-in. choke and straight stacks being probably the best sizes. The petticoat pipe can be easily adjusted by the use of a lever attached to the pipe, which can be guided by a bracket similar to that frequently employed for holding adjustable pipes. At least six heights of exhaust pipe should be used, varying from a pipe that is about 36 ins. from the choke of the stack to one that is 6 ins. above the face of the saddles. When the petticoat pipe is once adjusted for the exhaust pipe, the four stacks may be tested without further change, and by the vertical adjustment of the petticoat pipe with each diameter and height of stack a large number of observations may be made in a very short time and at slight expense. It might prove necessary to test two or more sizes and perhaps more than one form of petticoat pipe, but it would not be necessary to try these with each exhaust pipe, once the best of two or three forms was determined it would simply be necessary to check this result for two or three heights of exhaust pipe after the completion of the tests.

It must certainly be the object in these tests to so arrange the apparatus that a large number of observations can rapidly be made, and by making the stacks and petticoat pipes adjustable this can be done and in all probability it will be found unnecessary to complete the series, as judging from the uniformity of the results obtained in the Hanover tests from a steady jet, the first few tests would show in which direction further experimenting would be unnecessary, and we should endeavor to find what forms give the best results and avoid getting a lot of interesting information about those that don't.

Such a series of tests as above outlined should furnish sufficient definite information to permit of making a practically accurate statement of the results that are obtained from any ordinary arrangement of the front ends. It is always possible that improvements will arise that are not foreseen at present, but such an investigation as this would allow these improvements to be rated at their proper value and place the whole subject on a much more rational basis than it is at present.

(To be continued.)

The high-speed electric railway experiments which are being carried out in Germany are reported to have reached the speed of 99½ miles per hour up to the present time. This is the series of experiments which are being conducted on a short line of railway specially constructed for the purpose. For this speed a line pressure of 10,000 volts was required, and it is stated that with a few changes in construction the speed mentioned will be entirely practicable.

Piece work and premium systems are usually considered as applicable only to skilled workmen, and until the discussion of the subject at the December meeting of the American Society of Mechanical Engineers it is safe to say that most people would have ridiculed the suggestion that such systems could be applied to the shoveling of earth and coal and coke. On that occasion Mr. F. W. Taylor described an elaborate investigation as to the proper basic prices for shoveling and other work of similar charcter. When the results were put into practice the force of unskilled laborers (shovelers) which numbered between 400 and 500 men, was reduced to 85, who do the same work and whose wages have been advanced from $1.15 to $1.85 per day. The same principle was applied with equal success to the handling of pig iron.

The electric power plant at Niagara Falls has been in operation eight years. If it were to be built to-day and the same thorough-going method used in its design and construction were applied to-day, the eight years of experience since that time would not enable the engineers to improve the plant to affect the cost of power one dollar per kilowatt year. This is the judgment of Mr. L. B. Stillwell, expressed in a paper recently read before the American Institute of Electrical Engineers. No better tribute could possibly be paid to the wisdom of employing the very best available engineering talent in important works involving large expenditures. As industrial progress brings greater and greater engineering problems in all branches of activity, this policy should be widely extended. In such busy times the temptation to provide for the present is very strong. A better policy is to look as far as possible into the future and secure the best because it will last and because it will be good while it lasts. There is little of the engineer's work which does not last many years, whether it is an electrical plant, a bridge, a tunnel, a locomotive or a shop.

A retrogression instead of an advance along steam engineering lines is recorded in regard to the present management of the engineering department of our naval vessels by Admiral Melville in his recent report. The present plan places the engine room forces in charge of warrant machinists who are capable men, but who lack experience in the management of men. The difficulty lies in getting officers to devote themselves to the engineering of ships. The "line" is made more attractive and there is no provision for the needs of the future. If a return to the old plan of a separate staff for the engine room is not practicable, and it appears that it is not, something should be done to compel engine room experience on the part of the line officers. It would seem to be feasible to compel all line officers to serve in the engine room as a part of their qualification for promotion to the higher grades. Something of this sort must be done or engine room service must be made more attractive than it is by special privileges, such, perhaps, as providing better retirement conditions for this department. At present our navy is suffering because there is no inducement to make a specialty of steam engineering and no officer of spirit or promise will voluntarily take it up. Of course there will be an awakening to the results of this condition, but it is hoped that Admiral Melville's warning will be heeded in time to avoid a catastrophe. The present situation will bring one if it is not remedied. Because the safety of a war vessel depends first of all upon its machinery, we take the view that all line officers should have a thorough knowledge of this department as a qualification for commanding. Something radical and drastic seem to be necessary in order to overcome the disadvantages of the engineering department because of its discomforts. No better conclusion could possibly complete Admiral Melville's long record for loyal, able and efficient service than to urge the remedy of the present condition of affairs in this most vitally important department.

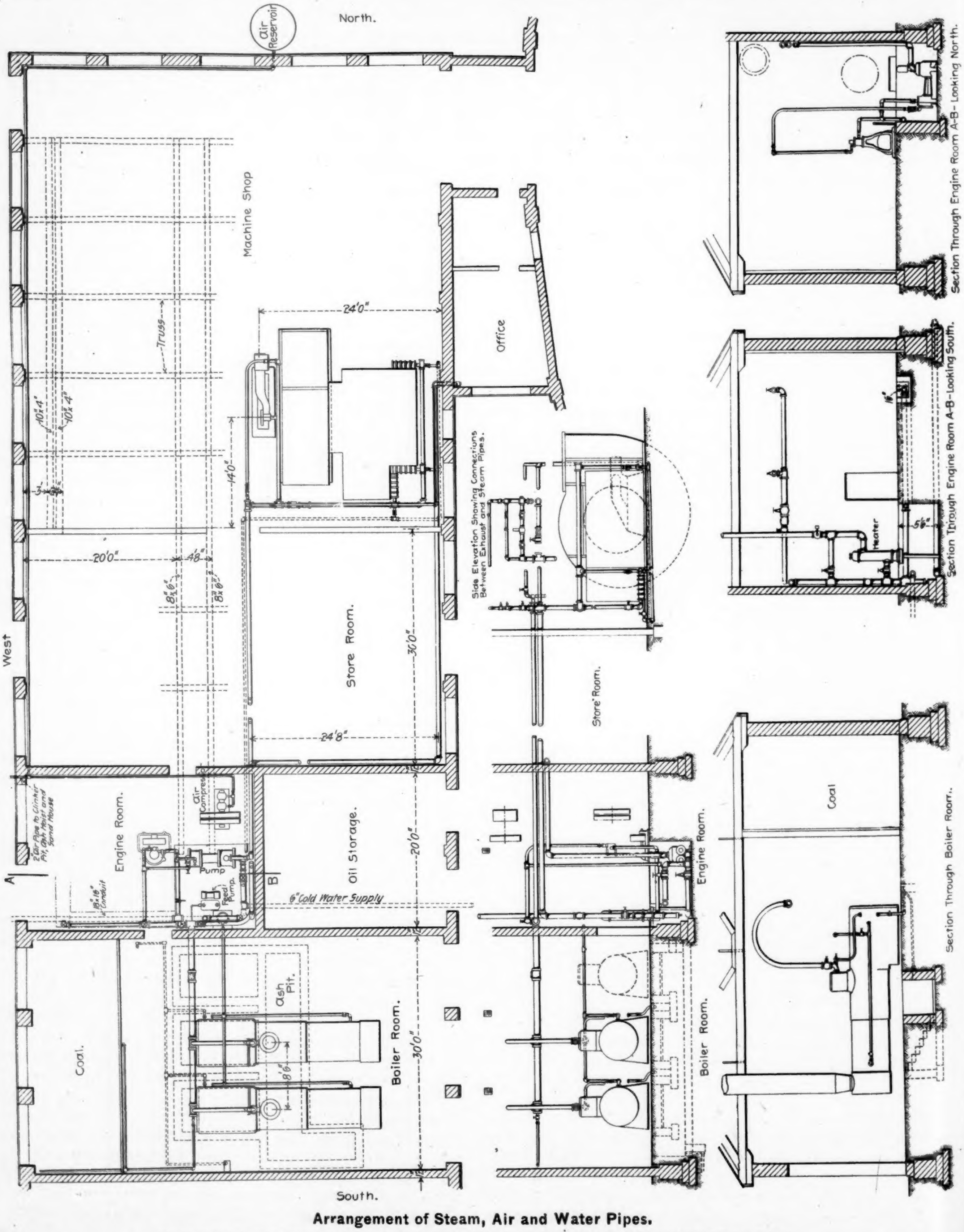
COLLINWOOD ROUNDHOUSE.

Lake Shore & Michigan Southern Railway.

Details and Appliances.

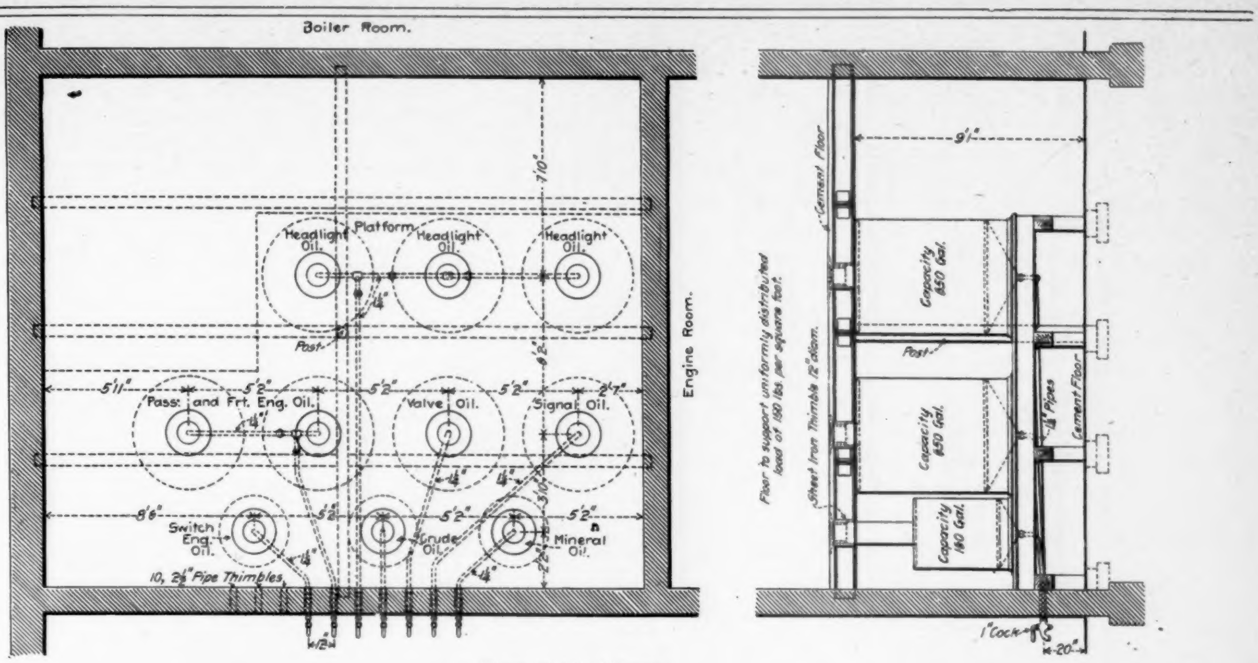
For the track layout and general plan of this complete and interesting locomotive terminal the reader is referred to the issue of October, 1901, page 305.

Nowadays shop facilities are needed at all locomotive terminals and in this case the treatment of roundhouse repairs is specially liberal because of the large amount of running repairs which are required by heavy engines making large mileage. This plan provides for more than doubling the roundhouse capacity, for ultimately using this shop for two large houses ana for enlarging the shop when necessary. Among the features of this plan is convenience in handling material, which

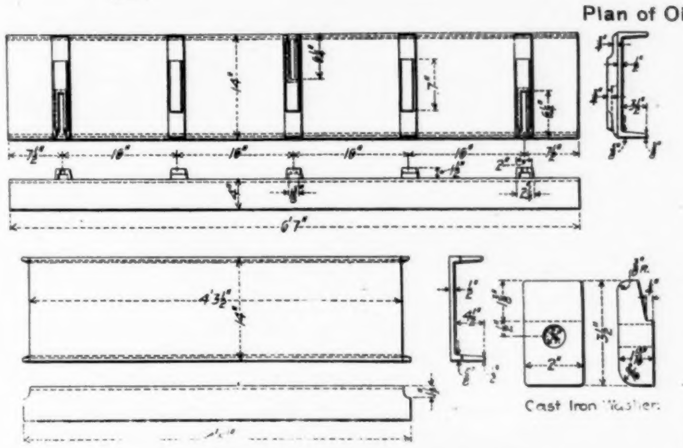


Arrangement of Steam, Air and Water Pipes.

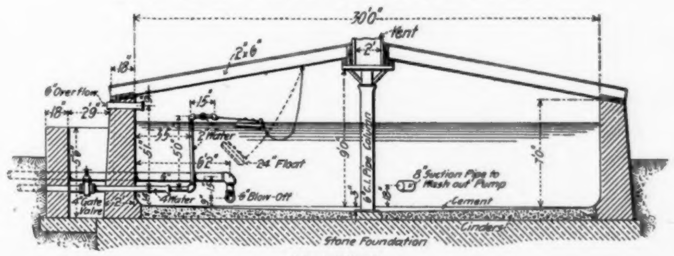
COLLINWOOD ROUNDHOUSE—LAKE SHORE AND MICHIGAN SOUTHERN RAILWAY.



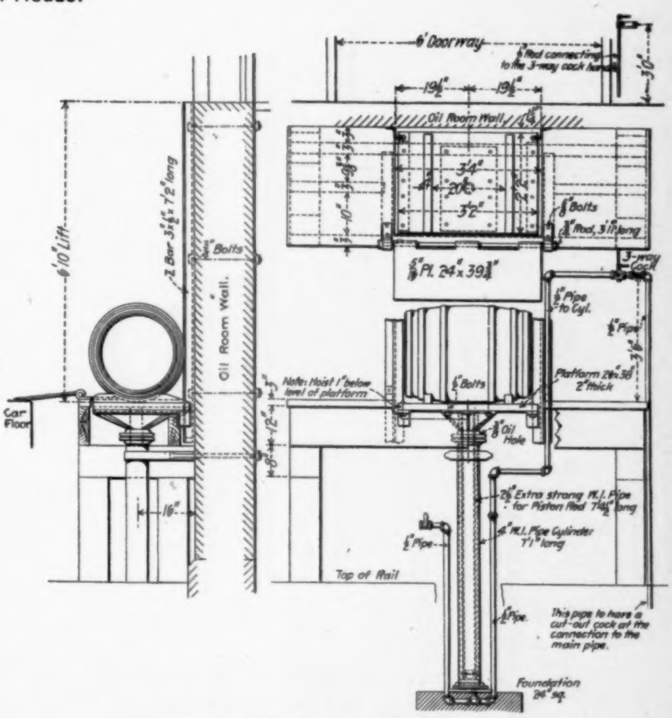
Plan of Oil House.



Cast Iron Rail Support for Roundhouse Pits.



Hot Well.

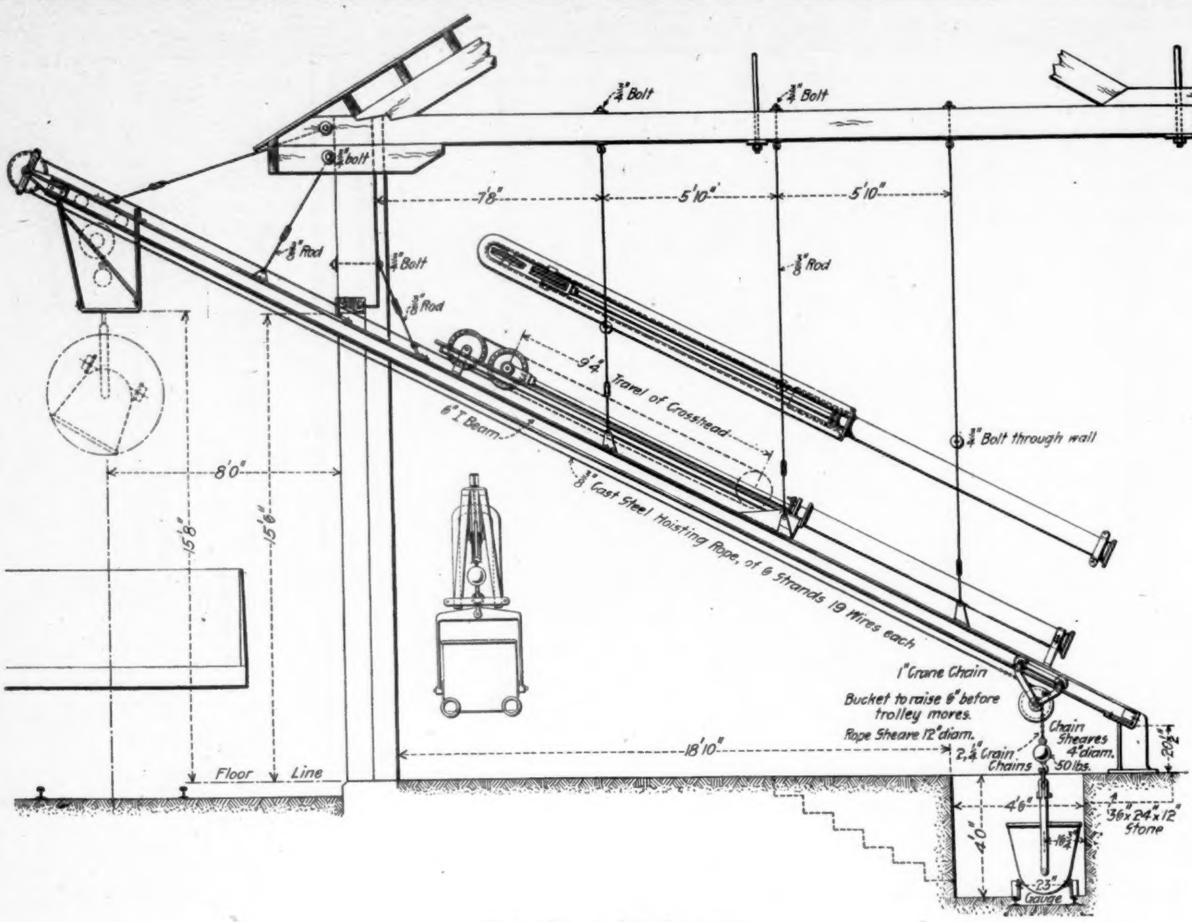


Pneumatic Elevator for Oil House.

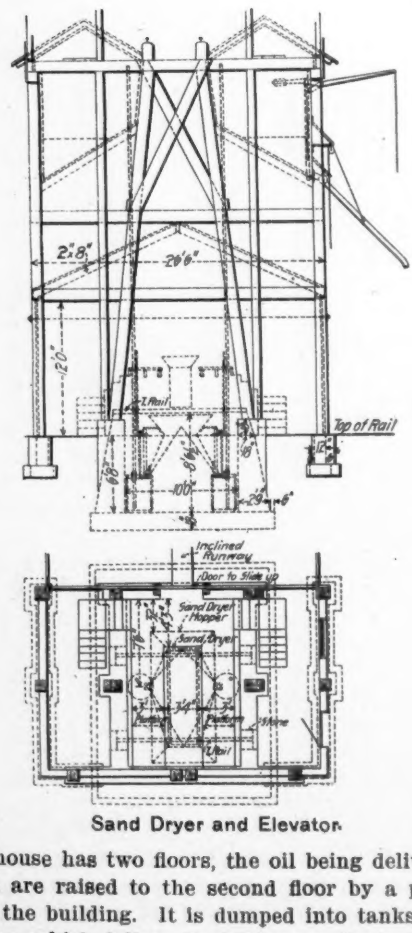
is brought by special tracks whereby the storeroom, oil room, coal storage and shop are easily reached. Wheels are also brought in here and taken directly to the roundhouse wheel pits from the shop, the pits being conveniently located for this purpose. For lighting, current is taken from the city mains to supply the following lights: Machine shop, 16 lamps; storeroom, 10; engine room, 4; oil house, 4; boiler room, 5; locker room, 13; office 5. All these are 16-candle incandescents. The roundhouse has two arc lamps and 107 incandescents of 32 candle power. The yard has four arcs and the sand house two incandescents, making in all 60 16-candle and 107 32-candle incandescents and 6 arc lamps.

The Sturtevant system of heating is used, and the heater is placed in the corner of the machine shop, where it may be duplicated when the second roundhouse is built. An 84 by 72 in. hot air conduit leads directly to the roundhouse, where it divides into two branches, one being 72 by 42-in. and the other 52 by 42-in., as illustrated in the description already referred to.

The present engravings illustrate the plan of the shop building, showing the boilers and piping for steam and water. The feed and washout pumps and heater are placed in a pit in the corner of the engine room. A compact but convenient arrangement of the boiler room is provided, in which the coal is received direct from the cars and kept in front of the boilers and the ashes are dropped into a pit under the boilers. They are received by a bucket which is mounted on small wheels running on a track through the pit. This bucket is run along to the end of the pit to an ingenious air hoist operated by a 7-in. cylinder, as shown in the engraving. This cylinder pulls a small carriage along an inclined 6-in. I-beam reaching from the pit to a car outside of the building. In raising the bucket the air cylinder pulls on the cable, which terminates at its lower end in a chain wound around a pulley suspended from the carriage. The first motion of the cable raises the bucket out of the pit because of the difference in diameters of the pulleys about which the cable and bucket chains are wound. When out of the pit the bucket is drawn up the incline and dumped automatically into the car with a single movement of the controlling valve.



Boiler Room Ash Conveyor.



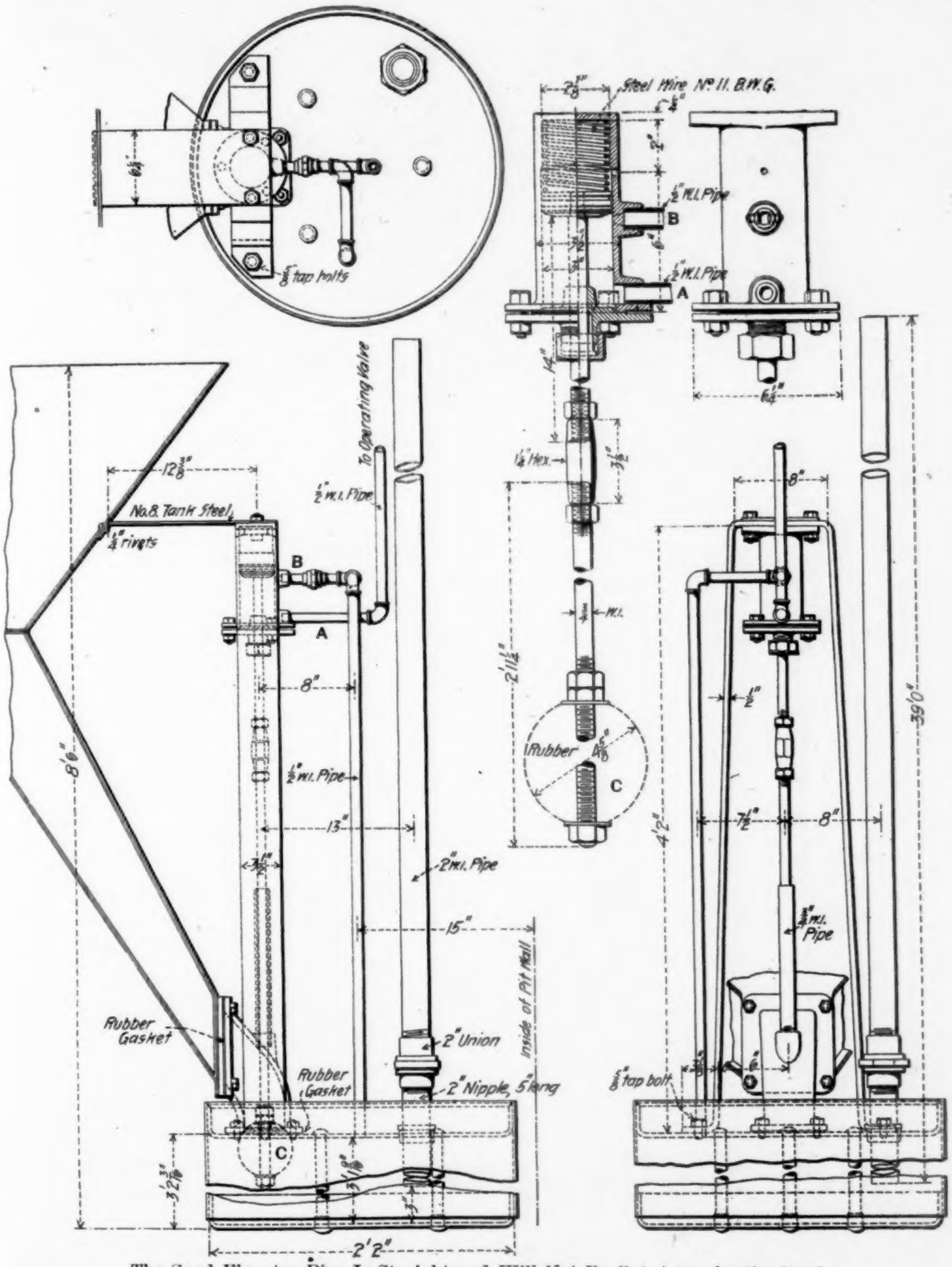
Sand Dryer and Elevator.

The oil house has two floors, the oil being delivered in barrels which are raised to the second floor by a plunger hoist outside of the building. It is dumped into tanks having conical bottoms, which deliver the oil by gravity to faucets in the storeroom. Five 650-gal. and three 160-gal. tanks are provided for storage, and barrels may be stored in the second story. This is a convenient arrangement, which is cared for by a man who has also other duties.

Locomotive sand is received in cars on the coal chute trestle and stored in a large bin at the end of the chute, where it drops to the ground level. It comes by gravity to the dryer room, and when dried runs into a large hopper, from which it is run into either of two large tanks below the ground. From these it is raised by air pressure to two storage pockets above and is delivered to the engines through spouts. In one of the detail views the pneumatic valves for elevating the sand are shown. The dryer operates continuously and when the underground tanks are full an air cock is opened and air is admitted to the pipe, A (see the sectional view of the valve mechanism). This raises the piston of this cylinder and raises the large rubber ball, C, against the delivery opening from the hopper, making an air-tight closure. When the piston of the operating cylinder is raised sufficiently to cut off the hopper opening the air passes out of this cylinder through the pipe B, which leads to the top of one of the underground tanks and raises the sana to the overhead bin by the direct application of the air pressure. This mechanism is arranged to permit of its operation by one of the coal chute men.

Near the roundhouse and shop is a 30-ft. hot water cistern, 7 ft. deep, built of concrete and roofed over. Into this the locomotives are blown off and the hot water is taken from it by the washout or feed pumps for washing out and filling boilers. A float valve automatically fills the well with cold water from the supply mains when the locomotives do not keep it full enough to insure condensing the steam blown into it. All the engines using this house are fited with a globe valve and special fitting upon the top of the steam dome and to this a connection is made to the steam blow off pipe which runs around under the roof of the roundhouse. This flexible connection has couplings for the domes and the blow-off pipe with interrupted threads. These couplings are slipped over each other and a quarter turn of the handles of the special fittings makes a tight joint at each end of the flexible connection. This being too heavy, a hose is now used.

The tool equipment of the shop in connection with this roundhouse includes one each of the following: 26-in. triple geared shaper; 36 by 36 in. by 12 ft. planer; 18-in. engine lathe with 5 ft. bed; 24-in. engine lathe; 30-in. drill press, sensitive drill; 1½-in. single Acme bolt cutter; double arbor emery grinder; blacksmith's forge; pipe bending block and two screw presses.



The Sand Elevator Pipe Is Straight and Will Not Be Cut Away by the Sand.

Pneumatic Sand Elevator.

Throughout the plan of this terminal provides to a greater extent than we have seen elsewhere for facilitating roundhouse work, and special study was given to all features which may contribute to a saving of labor and prompt work on the engines. The impression given in an examination of the terminal is one of judicious investment for the purpose of promoting prompt and efficient service. The details were worked out by Mr. H. L. Ball, Mechanical Engineer, under the direction of Mr. W. H. Marshall, Superintendent of Motive Power of the road.

The famous No. 999, the locomotive on the New York Central which attracted so much attention at the World's Fair in 1893 in Chicago and has done well-known service hauling the "Empire State Express," has come down to hauling a train of eleven milk cars and a caboose on the "West Shore" between Albany and Oneida. This engine is probably as good as it ever was, but the addition of one car to the "Empire State" made it necessary to assign the new "Central Atlantic" type engines to this service. They haul the train with ease, and the other was worked too near its limit of power, which explains the change. It is a marked example of recent progress in locomotive design.

Prof. H. Wade Hibbard in a recent address before the students of the Society of Mechanical Engineers of Sibley College, on the subject of "Engineering Periodicals and the Card Index," said in part: "Subscription to a paper should not be made in a hurry. And yet the reading from the start should be carried on with that end always in view. After the different papers become known, then the heart of the very human editor should be gladdened by a little note of appreciation—with some of that necessity for which he works, though not chiefly. A good engineering paper should be one of the life partners, ready at hand when moments of leisure permit its instruction and enjoyment, better understood and liked as the years roll on, acquaintance or perhaps friendship formed with the editor, contributions made, suggestions given and taken, some share had in its mighty influence in the engineering world."

The adoption of standard threads for pipe unions now seems assured. The committee on this subject reporting to the American Society of Mechanical Engineers at its recent convention had found it impossible to standardize the threads without also including the dimensions and forms of unions. The scope of the work had therefore been extended and plates for standard unions were submitted and accepted by the society. As this organization does not adopt standards, the recommendations will be placed before the Master Mechanics, Master Car Builders' associations and other associations having committees on the subject, and also before manufacturers, with a view of adoption. It is the intention to copyright the plates and give manufacturing privileges for a nominal sum, in order to prevent the use of bogus standards instead of those which are authorized. The subject will come before the Master Mechanics' and Master Car Builders' associations at Saratoga next summer.

HEAVY CONSOLIDATION COMPOUND LOCOMOTIVE.

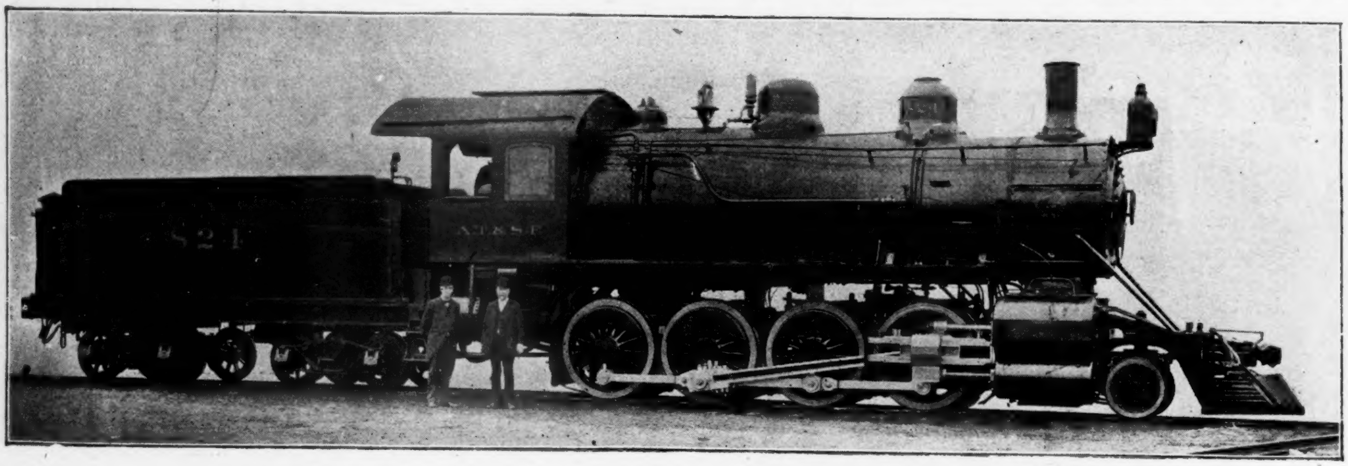
Atchison, Topeka & Santa Fé Railway.

With Three Corrugated Furnaces

For Oil Fuel.

There is nothing in the appearance of this locomotive to indicate that it has a boiler with three corrugated cylindrical furnaces for burning oil, or that the heating surface is the greatest ever used on a locomotive. It is a large, heavy, powerful engine, and is particularly interesting because its boiler is built specially for oil fuel. Its construction practically precludes the possibility of using coal. The design is an important one for this road, because of the possibility of building a large number of even larger engines with this boiler if it proves successful. The engine has a tractive power of 45,500 lbs. when working as a compound, and for starting can exert a pull of nearly 55,000 lbs. with live steam in the low pressure cylinders. Its place as a heavy engine is indicated in the accompanying comparative table.

In the boiler lies the chief interest of this engine. At the front course the diameter is 74 in.; following this is a conical dome course connecting to an 88-in. cylindrical course, and at the back end there is a tapered course. The dome course longitudinal seam is welded for a length of 9 in. at each end. The tubes, 652 in number and 1¾ in. in diameter, are 13 ft. 7 in. long. The three furnaces are 32 in. in diameter by 86 in.



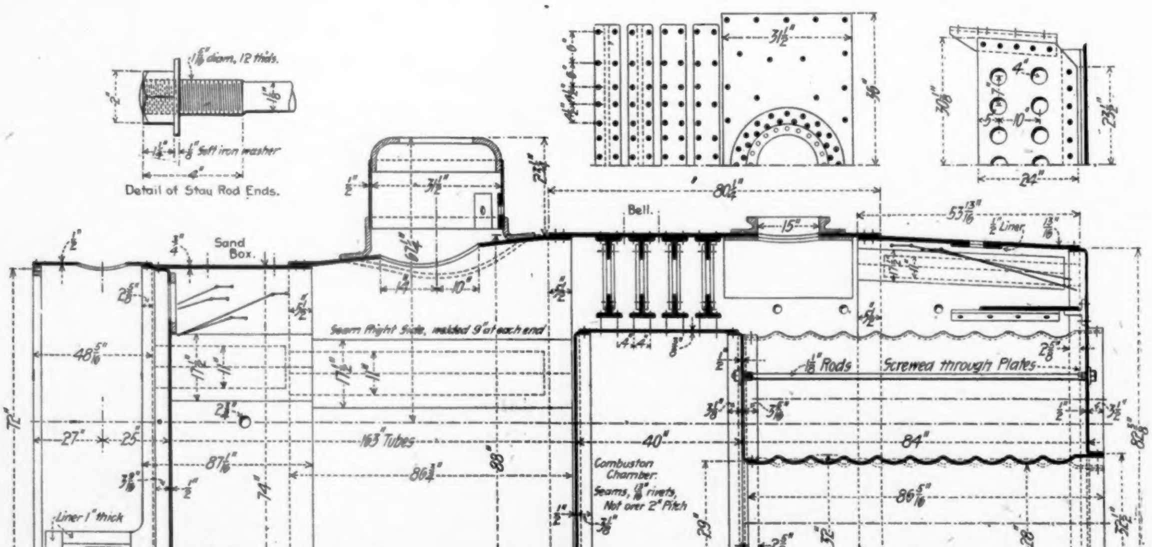
Oil Burning Locomotive with Three Fireboxes—Atchison. Topeka & Santa Fe Railway.

JOHN PLAYER, *Consulting Superintendent Machinery.*

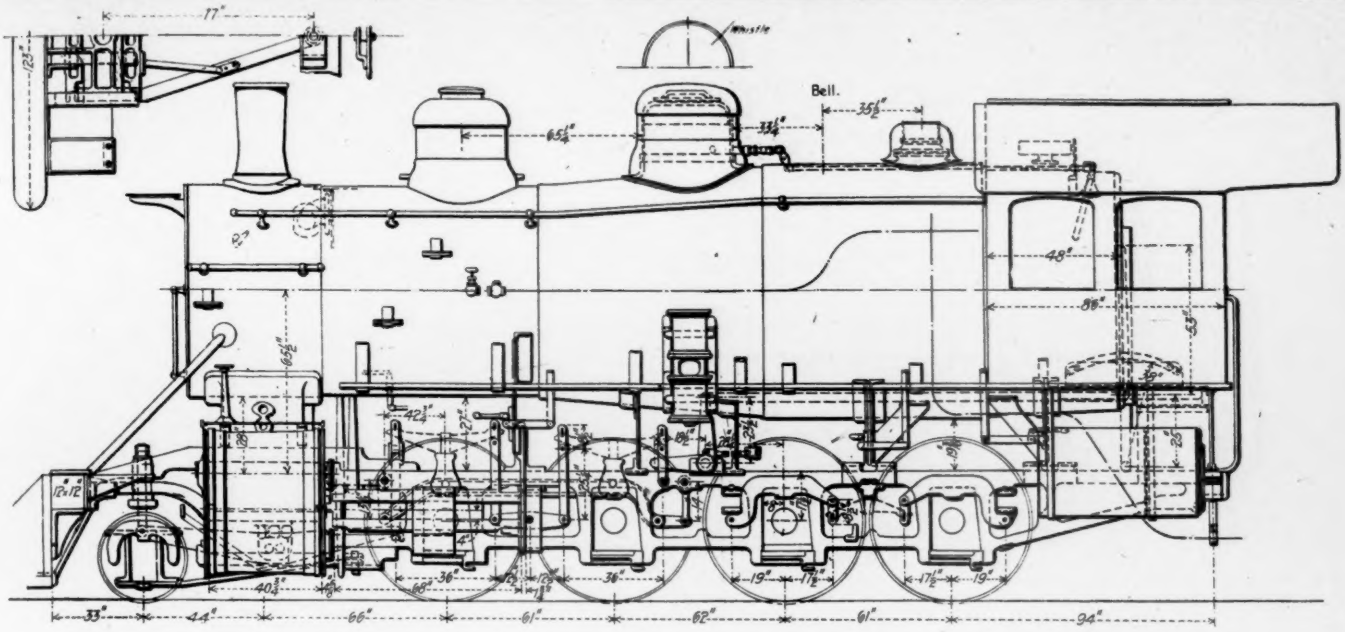
G. R. HENDERSON, *Superintendent Machinery:* BALDWIN LOCOMOTIVE WORKS, *Builders.*

COMPARISON OF HEAVY FREIGHT LOCOMOTIVES.

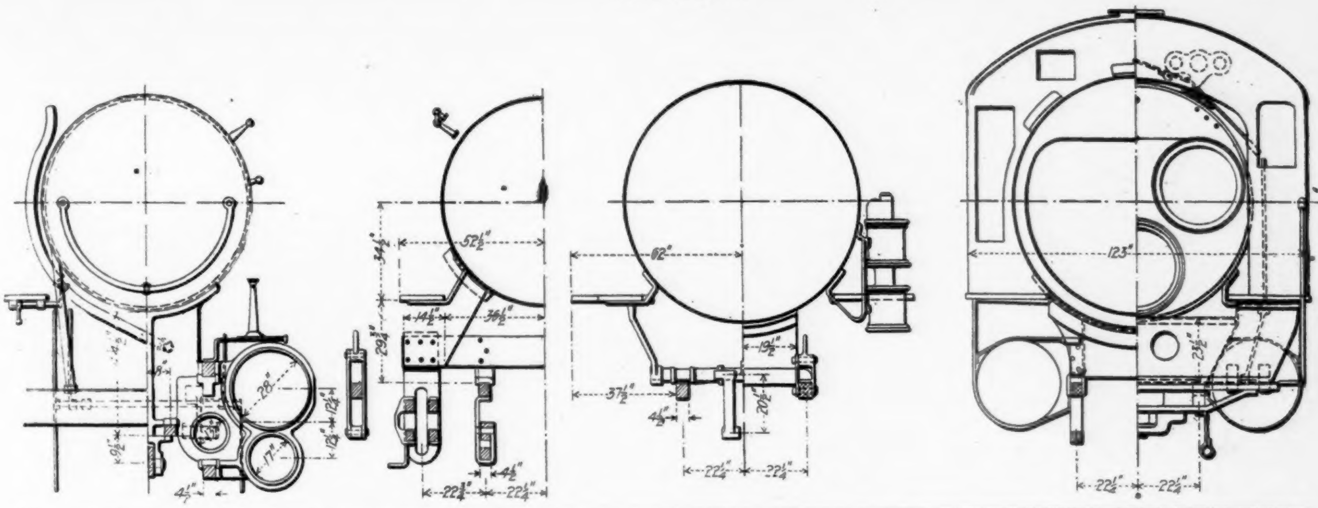
Railroad	P. B. & L. E.	Union	Lehigh Valley	Illinois Central	So. Pacific	Gt. Northern	Atchison.
Builder	Pittsburgh	Pittsburgh	Baldwin	Brooks	Schenectady	Brooks	Baldwin.
Simple or Compound	Simple	Simple	Vauclain Comp'd.	Simple	2-cyl. Comp'd	Simple	Vauclain Comp'd.
Type	Consolidation	Consolidation	Consolidation	12-wheel	Consolidation	12-wheel	Consolidation.
Total weight	250,300	230,000	225,082	232,200	193,000	212,750	214,600
Weight on drivers	225,200	208,000	202,232	193,200	173,000	172,000	191,400
Size of drivers	54 in.	54 in.	55 in.	57 in.	57 in.	55 in.	57 in.
Cylinders	24 x 32 in.	23 x 32 in.	18 and 30 by 30 in.	23 x 30 in.	23 and 35 x 34 in.	21 x 34 in.	17 and 28 x 32 in.
Heating surface	3,805 sq. ft.	3,322 sq. ft.	4,103.6 sq. ft.	3,500 sq. ft.	3,027.8 sq. ft.	3,280 sq. ft.	4,266 sq. ft.
Grate area	36.8 sq. ft.	33.5 sq. ft.	90 sq. ft.	37.5 sq. ft.	35.3 sq. ft.	34 sq. ft.	None.
Steam pressure	220 lbs.	200 lbs.	200 lbs.	210 lbs.	220 lbs.	210 lbs.	210 lbs.
American Engineer reference	1900 page 214	1898, page 365	1898, page 395	1899, page 315	1899, page 150	1898, page 1	This issue.



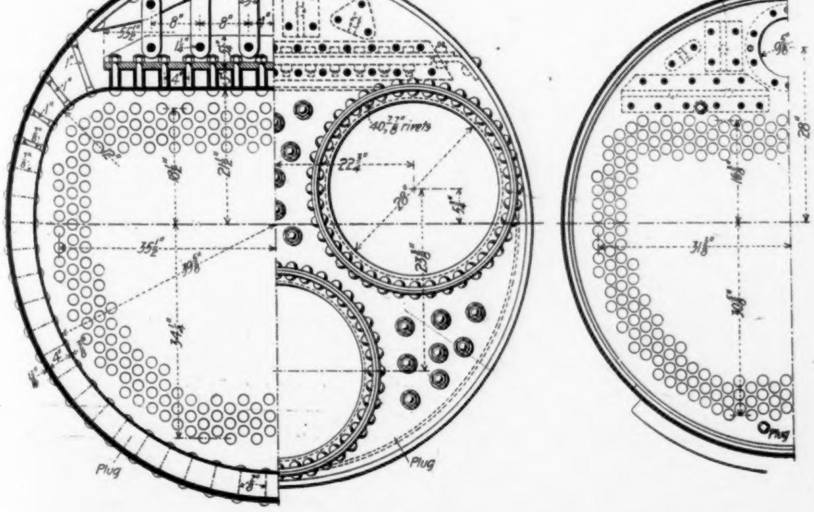
Longitudinal Section of Boiler.



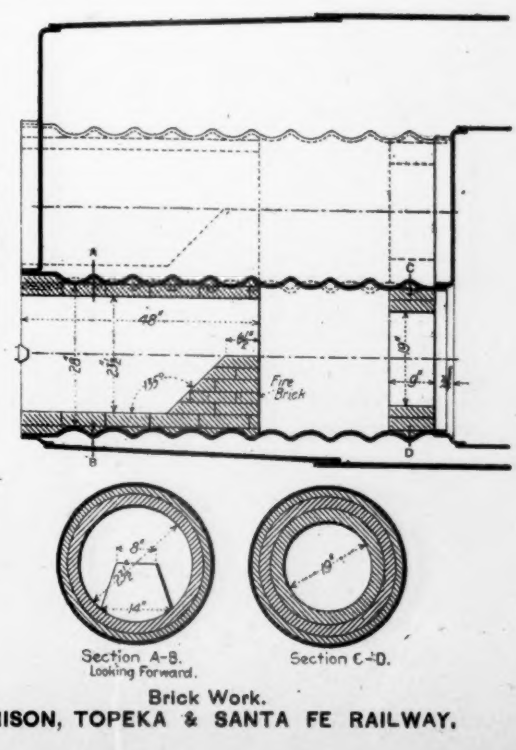
Side Elevation.



Half Rear and Front Elevations and Sections.

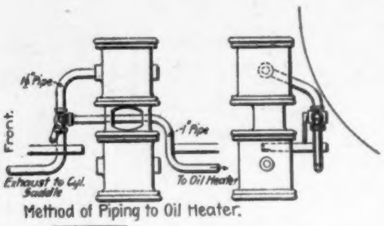


Transverse Section of Firebox.

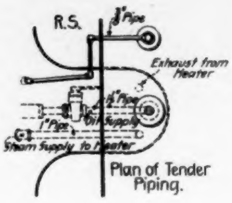


Brick Work.

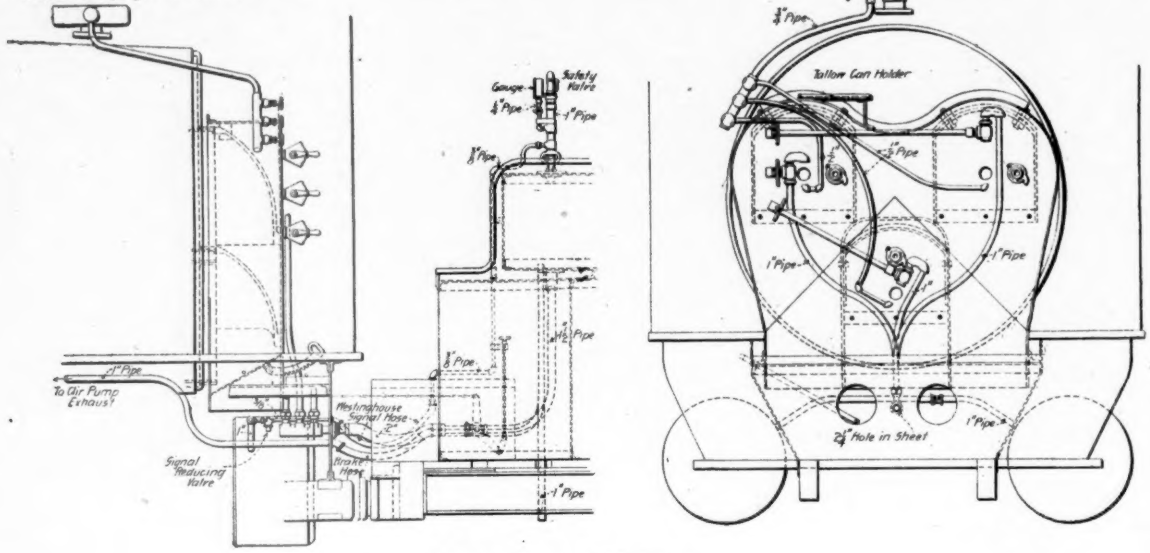
OIL BURNING LOCOMOTIVE WITH THREE FIREBOXES—ATCHISON, TOPEKA & SANTA FE RAILWAY.



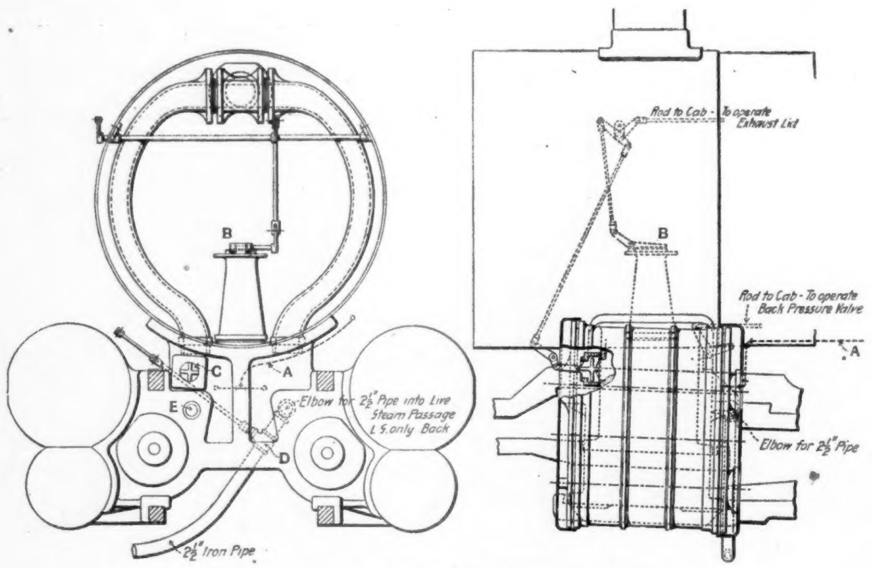
Method of Piping to Oil Heater.



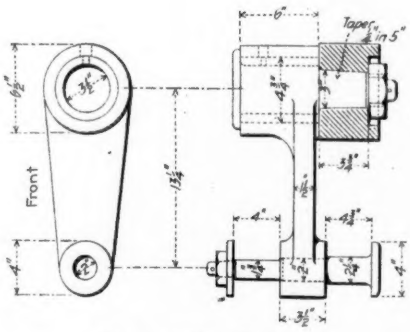
Plan of Tender Piping.



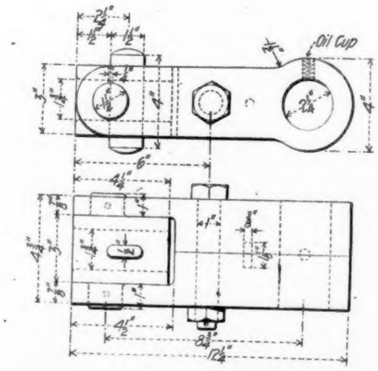
Arrangement of Oil Piping.



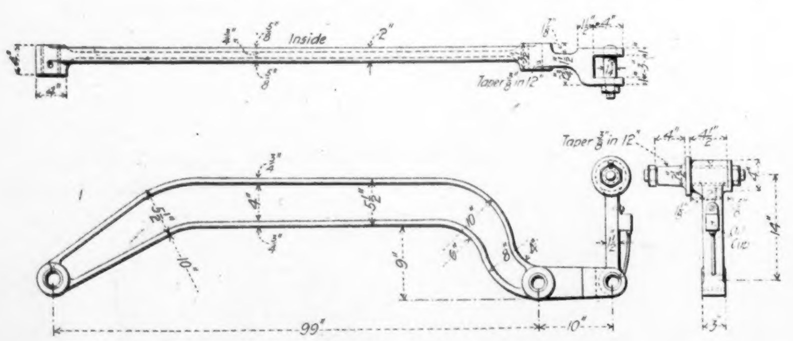
Arrangement of Baldwin Back Pressure Brake.



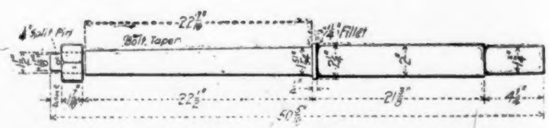
Valve Motion Rocker.



Connection to Valve Stem.



Motion Bar for Valve Motion.



Valve Stem.

OIL BURNING LOCOMOTIVE WITH THREE FIREBOXES, ATCHISON, TOPEKA & SANTA FE RAILWAY.

long, and rolled of ½-in. plate. These are connected to the rear plate of a combustion chamber, 40 in. long, of ⅜-in. plate, stayed by staybolts and sling stays to the shell, and by 1⅛-in. rods to the back head. The upper portion of the combustion chamber is flat and supported by Mr. Player's well-known arrangement of T section crown bars and short bolts. Except at the top of the combustion chamber the water space is 4 in.

One of the engravings shows the fire-brick protection for the furnaces and the brick obstruction to the flame which is built up in the center of each flue. The burners are placed centrally with the furnace flues. Another drawing shows the oil piping and location of the oil regulating valves. Each furnace flue has a 5-in. "fire door" opening, through which to watch the flame, and each has a curved cast-iron shield to protect the engine men in case of explosion of the oil in the furnace flues. Exhaust steam from the air pump is used to heat the oil. The tender carries 2,200 gallons of oil and 6,000 gallons of water.

Among the details are a short smoke box, 52 in. long, having frames of cast steel; main driving journals, 9½ by 12 in., and the other driving journals 9 by 12 in. The equalization system divides between the second and third pairs of driving wheels. To pass the first and second driving axles a long I section motion bar is used. This connects with the rocker, and the rocker connects with the valve stem by means of a short link, which is split lengthwise and at its forward end embraces the trunnions of a block which receives the end of the valve stem. The valves are very large, 13 in. in diameter.

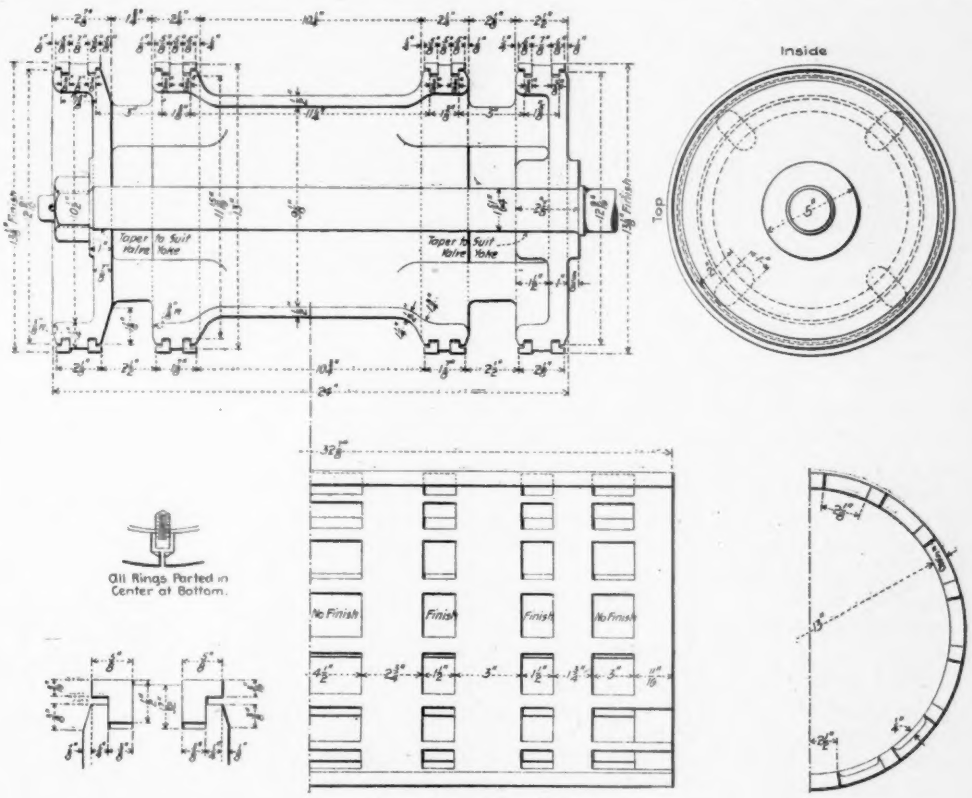
A new form of back pressure brake, on the principle of the Le Chatelier water brake, is used on this engine, and, in fact, on a large number of recent Vauclain compounds, including the large passenger engines for this road, illustrated in our December number. This brake takes air into the exhaust passages through automatic, inwardly opening valves and, when drifting, the smoke box gases are excluded from the exhaust nozzle by a cover. The use of this brake requires the driver brakes to be cut out; the regular employment of the air brake for the tender and train is, however, not interfered with. When the engine is drifting forward, the reverse lever is thrown in to back gear, the Chatelier valve in the cab is opened, supplying steam to the exhaust passages or the cylinder (at A in the engraving), and the damper (B) is closed over the exhaust nozzle, air being admitted to the exhaust passages through the inlet valve (C), and the steam is compressed in the cylinders and steam passages, thus retarding the motion of the pistons, also retarding the wheels, through the medium of the connecting rods. The accumulated pressure may be relieved through the gate valve (D), which is operated by a lever in the cab, so that the engineer may control the pressure to suit the existing conditions. A safety valve (E) is placed in the cylinder saddle to protect the passages against excessive pressure. There are two inlet valves, C, one on each side of the engine. In the side view, shown in dotted lines, is a rod and a plunger to hold these valves open and prevent them from clattering, but it has not been found necessary to use this attachment. The function of the steam is to keep down the temperature from the friction.

The description of this engine is completed by the following table of dimensions:

OIL BURNING CONSOLIDATION LOCOMOTIVE.

Atchison, Topeka and Santa Fe Railway.

Fuel	Oil
Weight on drivers	191,400 lbs.
Weight on truck wheels	23,200 lbs.
Weight, total	214,600 lbs.
Weight tender loaded	110,000 lbs.
Wheel base, total, of engine	24 ft. 6 in.
Wheel base, driving	15 ft. 4 in.
Wheel base, total (engine and tender)	54 ft. 2¾ in.
Length over all, engine	39 ft. 8¾ in.
Length over all, total, engine and tender	65 ft. 7¼ in.
Height, center of boiler above rails	9 ft. 2 in.
Height of stack above rails	15 ft. 4 in.
Heating surface, fire-boxes	165 sq. ft.
Heating surface, tubes	4,031 sq. ft.
Heating surface, comb. chamber	70 sq. ft.
Heating surface, total	4,266 sq. ft.
Drivers, diameter	57 in.
Drivers, centers	Cast steel.
Truck wheels, diameter	30 in.
Journals, driving axle, size	Main, 9½ x 12 in.; others, 9 x 12 in.
Journals, truck axle, size	6½ x 10½ in.
Main crank pin, size	6¾ x 6¾ in.
Cylinders, diameter	H. P., 17 in.; L. P., 28 in.
Piston, stroke	32 in.
Piston rod, diameter	4½ in.
Main rod, length center to center	10 ft. 10 in.
Steam ports, length (circular)	29¾ in.
Steam ports, width	1½ in.
Exhaust ports, length (circular)	29¾ in.
Exhaust ports, width	4½ in.
Bridge, width	3 and 2¾ in.
Valves	13 in. dia., Balanced piston.
Valves, greatest travel	5¾ in.
Valves, outside lap	H. P., ⅞ in.; L. P., ¾ in.
Valves, inside clearance	H. P., ¼ in.; L. P., ⅜ in.
Valves, lead in full gear	H. P., 0 in.; L. P., ⅛ in.
Boiler, working steam pressure	210 lbs.
Boiler, material in barrel	Steel.
Boiler, thickness of material in barrel	¾ in. and 13-16 in.
Boiler, diameter of barrel	74 in.
Seams, kind of horizontal	Butt jointed, double covering strips.
Seams, kind of circumferential	Double riveted, 1¼ in. riv.
Thickness of tube sheets	½ in.
Thickness of crown sheet	⅜ in.
Crown sheet stayed with	Inverted T-iron crown-bars.
Dome, diameter	31½ in.
Fire-boxes, length	7 ft. 0 in.
Fire-boxes, diam., inside	2 ft. 4 in.
Fire-boxes, diam., outside	2 ft. 8 in.
Comb. chamber, length	3 ft. 4 in.
Fire-boxes, material	Steel.
Fire-boxes, thickness of sheets	½ in.
Tubes, number	652.
Tubes, material	Iron, No. 13 W. G.
Tubes, outside diameter	1¾ in.



Vauclain Piston Valve.

Tubes, length over sheets	13 ft. 7 in.
Smoke-box, diameter inside	74 in.
Smoke-box, length	52 in.
Exhaust nozzle	Single.
Exhaust nozzle, diameter of thimbles	4½, 4¾ and 5 in.
Exhaust nozzle, distance of tip below center of boiler	7 in.
Stack	Taper.
Stack, least diameter	15⅝ in.
Stack, greatest diameter	17⅜ in.
Stack, height above smoke-box	3 ft. 0 in.
Tender.	
Type	Swivel trucks.
Tank capacity for water	6,000 gals.
Oil capacity	2,200 gals.
Kind of material in tank	Steel.
Thickness of tank sheets	¼ in. and 5-16 in.
Type of under-frame	10 in. steel channel.
Type of truck	Player, cast steel.
Truck with swinging motion or rigid bolster	Rigid.
Type of truck spring	Elliptic.
Diameter of truck wheels	34¼ in.
Diameter and length of axle journals	5 x 9 in. M. C. B.
Distance between centers of journals	6 ft. 4 in.
Diameter of wheel fit on axle	6⅜ in.
Diameter of center of axle	5⅜ in.
Type of truck bolster	Player, cast steel.
Type of truck transom	Player, cast steel.
Length of tender frame over bumpers	23 ft. 10½ in.
Length of tank	22 ft. 6 in.
Width of tank	9 ft. 6 in.
Height of tank, not including collar	4 ft. 2 in.
Height of tank over collar	6 ft. 1 in.
Type of back draw-head	Tower coupler, tandem.
Draft rigging	Miner.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The proposed increase of membership dues in the American Society of Mechanical Engineers was rejected at the December convention by a vote of 647 to 191, and the incident, as far as the dues are concerned, is closed. Before the meeting many guessed at the reason for the suggested increase and one guess was as good as another. No one suspected, not even the members of the council, that the society was in debt to the amount of about $13,000, but this unwelcome fact came out in the discussion, and the result is an evident intention on the part of the council to thoroughly investigate the financial affairs for the purpose of remedying the difficulty as it should be remedied, by business-like management rather than by an increase in revenue. As the membership increased the cost of the service to the members, of which printing is the largest item, increased per member instead of decreasing, as it should, and it was made clear in the discussion that other similar societies gave more to their members on a lower scale of dues. A report of the discussion is not necessary here, but we desire to indicate that at present there is no definite authority in direct control of the current expenditures, to whom the secretary must apply before incurring bills. This should be changed, and it probably will be, for the voice of the membership, which was expressed extensively by means of proxies, was clear and definite in favor of retrenchment, although the existence of the debt was not suspected. At a meeting of the council, held before the convention, a possibility of saving $4,000 per year was readily found. Proxy votes in this society under the laws are rare, if they have ever been used before, and one result of this question was the suggestion of a change in the constitution which when enacted will provide for letter ballot in deciding upon future amendments, and this will avoid the necessity for proxies. This question is disposed of, but its effect will probably be important and lasting, for the thorough ventilation of the situation resulted in a clear expression of the necessity for a general improvement in the management which cannot fail to affect beneficially the entire work of the organization. The council should now take all of the membership fully into its confidence and should solicit from all members suggestions which may tend toward placing this society upon the high plane which it should occupy, but at present does not. The good work should not stop until the proceedings reflect in every branch of mechanical engineering the "state of the art." In this they are now deficient. But this must not be left to the secretary alone. The thoughtful and conscientious co-operation of the entire membership is needed if the society is to fill the place it ought to fill as the most important engineering association in the country.

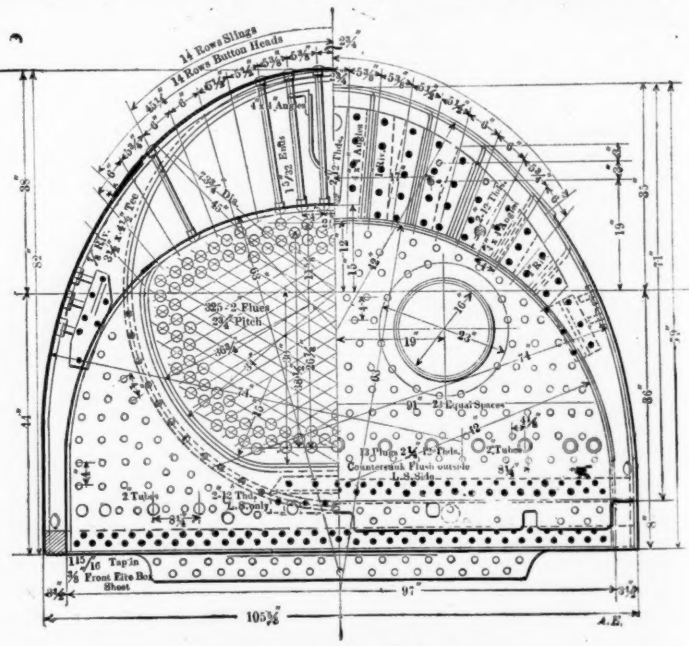
"CHATAUQUA" TYPE PASSENGER LOCOMOTIVES.

Central Railroad of New Jersey.

The Heaviest Four-Coupled Passenger Locomotives.

Three of the locomotives illustrated by these engravings were built at the Brooks Works of the American Locomotive Company and put into service on the Central Railroad of New Jersey last September. They are used in exacting passenger service between New York and Philadelphia, and are proving themselves to be very satisfactory. Having the distinction of being the heaviest of the four-coupled type ever built, they are specially worthy of record. Mr. McIntosh, Superintendent of Motive Power of this road, has long been of the opinion that it is a mistake to sacrifice strength and reliability in service by making the parts of locomotives too light, and this extraordinary total weight of 191,000 lbs. was employed with a view of "preventing the engines from shaking themselves to pieces" rather than to secure the utmost limit of power from the allowable weight. He was, therefore, satisfied with somewhat less heating surface than has been obtained with much lighter engines. In carrying out this idea he was fortunate in being able to take advantage of a boiler fired with anthracite coal on a grate of 82 sq. ft. area. Such boilers are powerfully good steamers, and so they have proved in this case.

The Vauclain 10-wheel compounds of the Lehigh Valley, an outline of which was shown on page 312 of our volume of 1900, have a total weight of 194,758 lbs., but the new Chautauqua type engines, while not the heaviest passenger engines, are heavy enough. We know of no other engines now running in this country having 85-in. driving wheels and very few having as great a weight, 99,400 lbs., on four driving wheels. The Pennsylvania Atlantic type engines, Classes E1 and E2,



Transverse Section of Boiler.
"Chautauqua" Type Passenger Locomotive.

weigh 101,550 and 109,033 lbs. on driving wheels, respectively. These are believed to be the heaviest weights in use on four wheels.

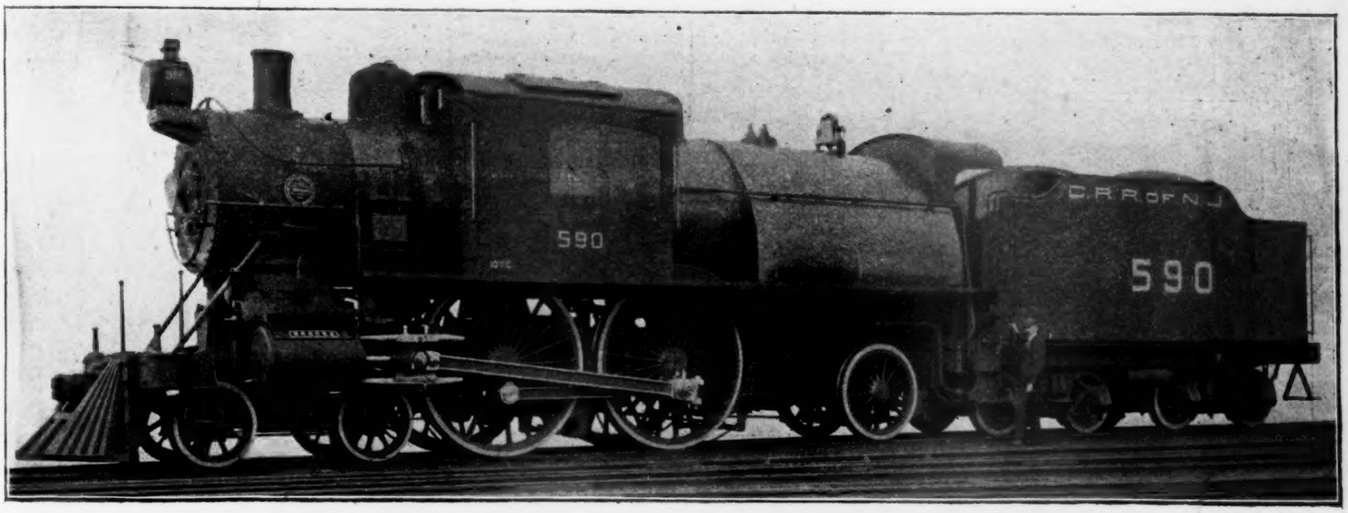
The height of the center of these boilers of the Chautauqua type engines is 9 ft. 8½ ins., which is unusually high, although less than that of the recent 10-wheel freight engines of the Chicago, Rock Island & Pacific, which is 9 ft. 10⅞ ins. above the rail. In this connection it is interesting to know that this combination of large wheels, heavy weight and high boilers results in very easy riding, this feature of the Jersey Central engines being noteworthy. In order to conveniently compare the four leading examples of the "Chautauqua" type, from the

Brooks Works, showing the steps in progression, to the present development, the following table has been prepared:

"Chautauqua" Type Locomotives.

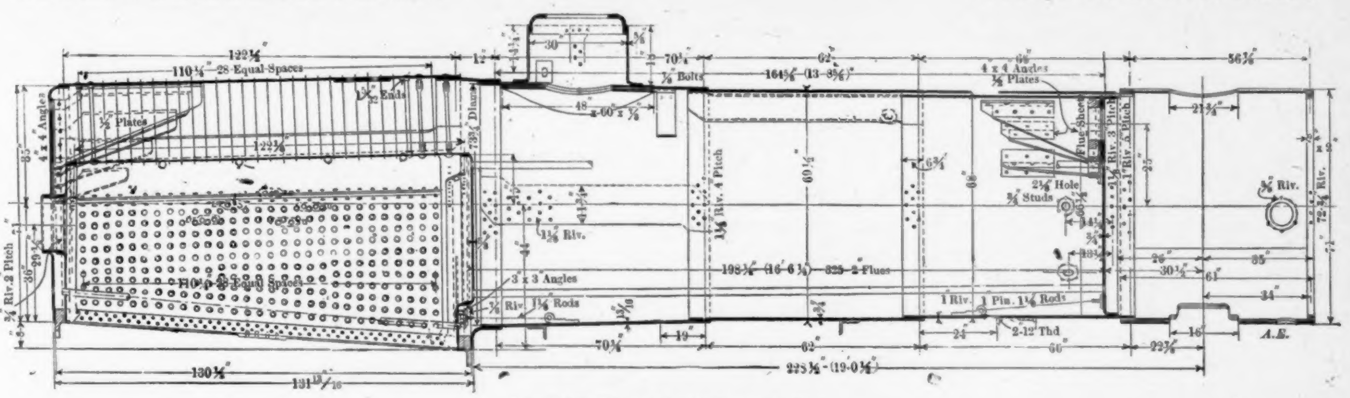
	B.,C.R.&N.	C.,R.I.&P.	B.R.&P.	C.R.R. of N.J.
Total weight, lbs.	158,600	167,000	173,000	191,000
Weight on drivers, lbs.	88,000	93,500	99,000	99,400
Heating surface, sq. ft. ..	2,551	2,806	3,007.9	2,967
Grate area, sq. ft.	45.3	55.7	54.4	82
Boiler pressure, lbs.	210	210	220	210
Clyinders, diameter (ins.)..	19½	20¼	20¼	20½
Cylinder, stroke (ins.).......	26	26	26	26
Drivers, diameter (ins.).....	*75	†78½	‡72	**85

Illustrated in "American Engineer" as follows: * Dec., 1900, p. 375; † April, 1901, p. 101; ‡ This issue; ** This issue.



"Chautauqua" Type Passenger Locomotive.—Central Railroad of New Jersey.

WM. MCINTOSH, *Superintendent Motive Power.* AMERICAN LOCOMOTIVE CO., *Builders.*



Longitudinal Section of Boiler.

Among the details of the present design the following may be noted. The trailing truck is the Player radial type, similar to that of the "Prairie" type engines of the Lake Shore, illustrated on page 74 of our March number, 1901. The firebox is 123 ins. long and 97 ins. wide, fitted with grates for fine anthracite coal, and having two fire doors. The firebox is supported by plates. The tubes are 16 ft. 6¼ ins. long. The ash-pan doors are hung on compensated links, as shown in the side elevation. A boiler brace extends to the front rails of the frames and another to the grate yoke on each side. At the rear of the main driving boxes the frames are offset downward to secure room for a good slope to the ash pan. Across the engine, and in front of the firebox a transverse equalizer is carried. A cast-steel rocker is used in connection with the valve gear, which is direct motion, the rocker having a double bearing. The piston valve is 11 ins. in diameter. With these weights large journals were required. The driving journals are 9½ by 12 ins., the trailers 8 by 14 ins., and the truck journals 6 by 12 ins. A table of the chief dimensions follows:

CHAUTAUQUA TYPE PASSENGER LOCOMOTIVE.

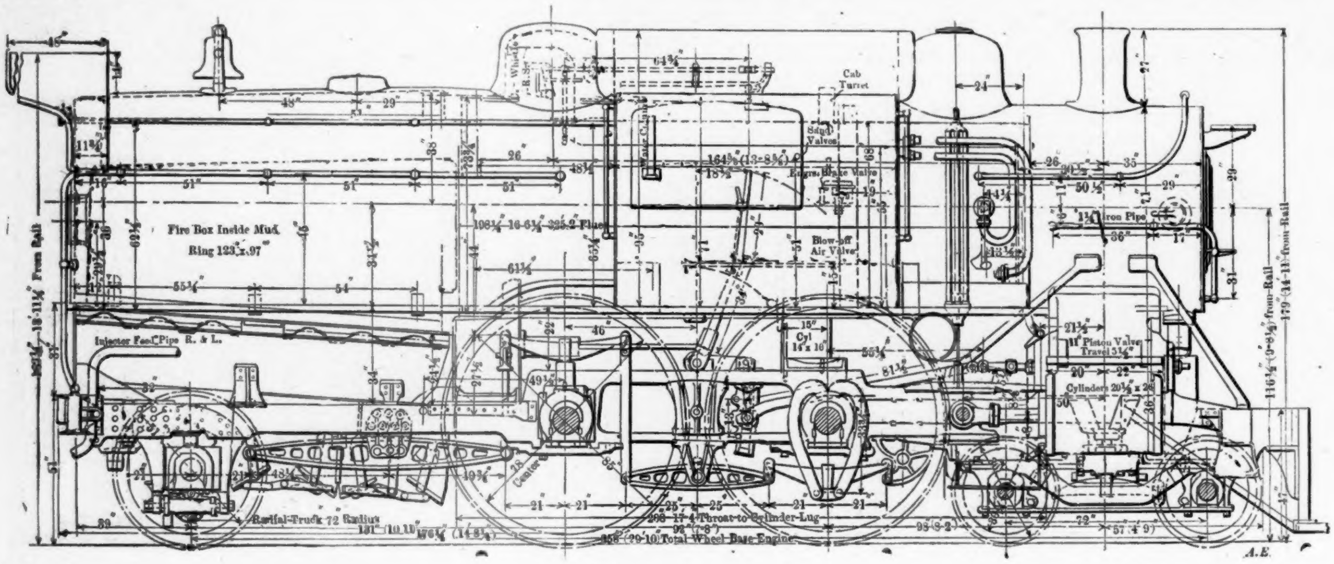
Central Railroad of New Jersey.

Gauge	4 ft. 8½ ins.
Kind of fuel to be used....................	**Fine anthracite coal**
Weight on leading wheels....................	48,000 lbs.
Weight on driving wheels....................	99,400 lbs.
Weight on trailing wheels	43,200 lbs.
Weight on total	191,000 lbs.
Weight tender, loaded	124,000 lbs.
Wheel base, total of engine....................	29 ft. 10 ins.
Wheel base, driving	7 ft. 8 ins.
Wheel base, total engine and tender....................	53 ft. 8 ins.
Length over all, engine....................	39 ft. 8⅝ ins.
Length over all, total engine and tender....................	69 ft. 8 ins.
Height center of boiler above rail....................	9 ft. 8½ ins.
Height of stack above rail	14 ft. 11 ins.
Heating surface, firebox....................	174 sq. ft.
Heating surface, tubes	2,793 sq. ft.
Heating surface, total	2,967 sq. ft.
Grate area	82 sq. ft.
Wheels, leading, diameter	36 ins.
Wheels, driving, diameter	85 ins.
Wheels, trailing, diameter	51 ins.
Material of wheel centers	All cast steel
Type of trailing wheels....................	Improved radial axle
Journal, leading axles	6 by 12 ins.
Journal, leading axles, wheel fit....................	6½ ins.
Journal, driving	9½ by 12 ins.
Journal, driving axles, wheel fit....................	9½ ins.
Journal, trailing axles	8 by 24 ins.
Journal, trailing axles, wheel fit....................	7⅞ ins.
Cylinder diameter	20½ ins.
Cylinder stroke	26 ins.
Piston rod diameter	4 ins.
Main rod length center to center....................	140 ins.
Steam ports, length	25½ ins.
Steam ports, width	1¾ ins.
Exhaust ports, leasts area	75 sq. ins.
Bridge width	3⅛ ins.
Valves, kind of	Piston
Valves, greatest travel	5¾ ins.
Valves, steam lap (inside)	1¼ ins.
Lead in full gear	3/32 ins.
Lead, constant or variable	Variable
Boiler, type of	Wagon top
Boiler, working pressure	210 lbs.
Boiler, material in barrel	Steel
Boiler, thickness of material in shell..	¾ ins., 13/16 ins., ½ in., 9/16 in.
Boiler, thickness in tube sheet....................	¾ in.
Boiler, diameter of barrel front....................	68 ins.
Boiler, diameter of barrel at throat....................	73¾ ins.
Seams, kind of horizontal	Sextuple
Seams, kind of circumferential	Triple
Crown sheet stayed with	Radial stays
Dome, diameter inside	30 ins.
Firebox, type	Wide
Firebox, length	123 ins.

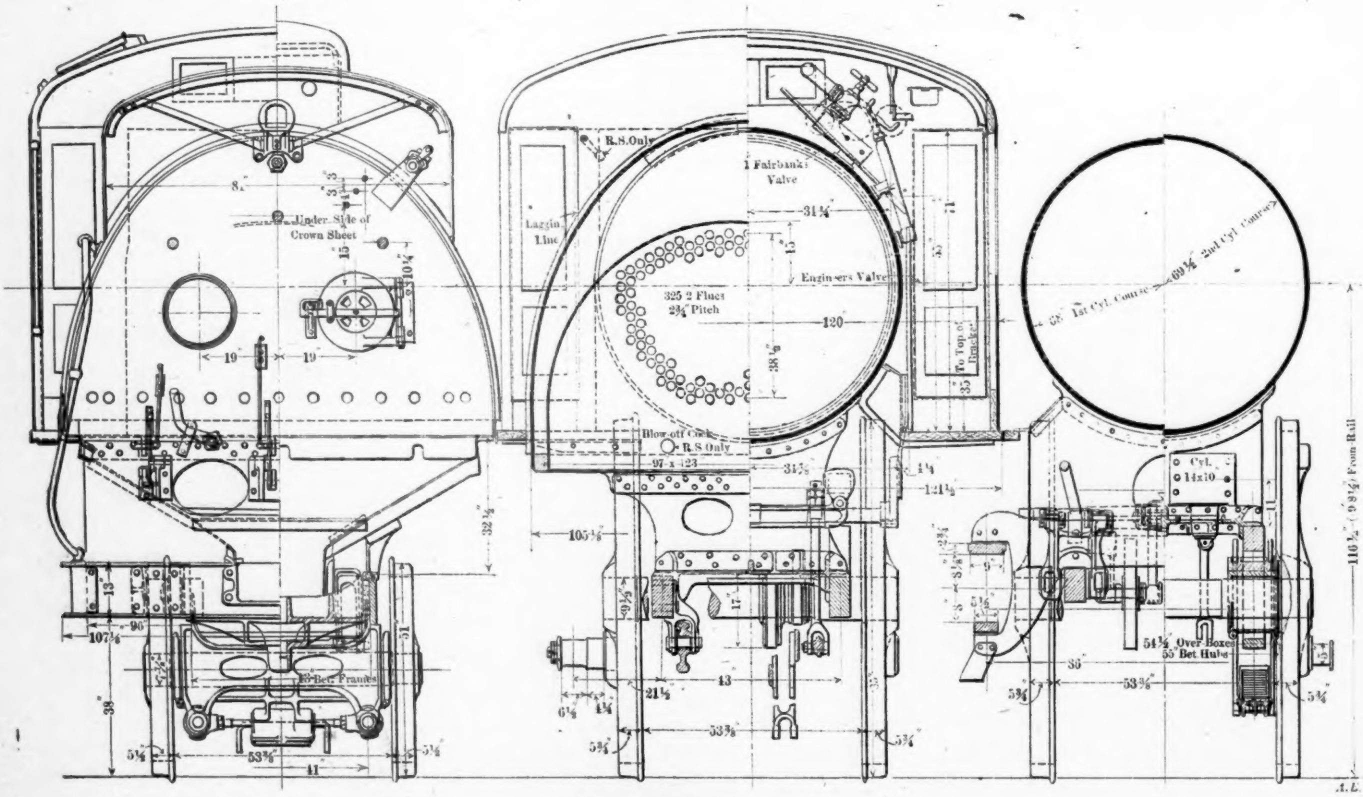
Firebox, width .... 97 ins.
Firebox, depth, front .... 59 ins.
Firebox, depth, back .... 48 ins.
Firebox, material .... Steel
Firebox, thickness of sheets..Crown, ⅜ in.; tube, ⅝ in.; side, ⅜ in.
Firebox, brick arch .... None
Firebox, mud ring width ....3½ ins. back, 3½ ins. sides, 4 ins. front
Firebox, water space at top..4½ ins. back, 5½ ins. sides, 4 ins. front
Grates, kind of .... Rocking
Tubes, number of 325
Tubes, material .... Charcoal iron
Tubes, outside .... 2 ins.
Tubes, thickness .... 12 B. W. G.
Stack, greatest diameter .... 16⅝ ins.
Stack, height above smokebox .... 27 ins.

Tender.

Type .... 8-wheel steel frame
Tank type .... Slope top
Tank, capacity for water .... 6,000 gals.
Tank, capacity for coal .... 12 tons
Tank material .... Steel
Tank, thickness of sheets .... ¼ in.
Type of under-frame .... Steel channel
Type of trucks .... Brooks all metal trucks



Side Elevation.



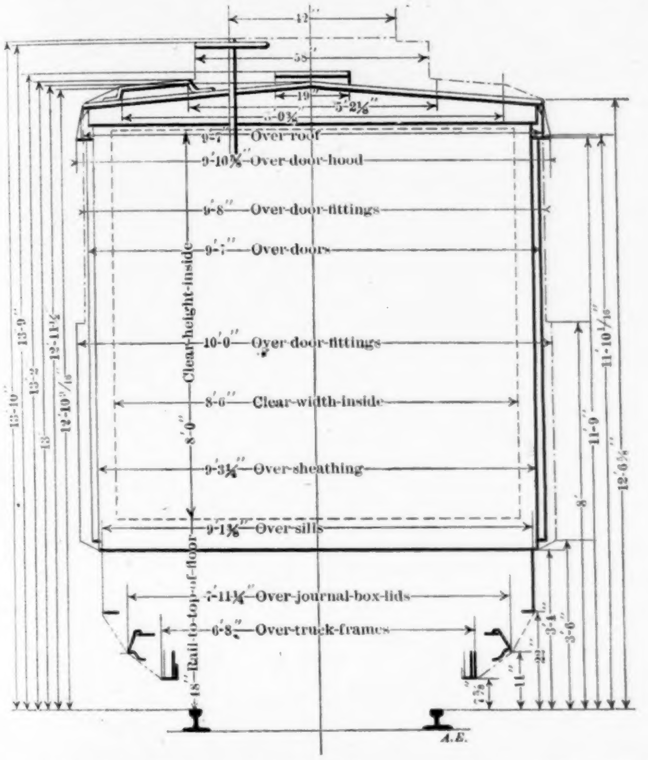
Half Rear Elevation and Sections.

"CHAUTAUQUA" TYPE PASSENGER LOCOMOTIVE—CENTRAL RAILROAD OF NEW JERSEY.

Tubes, length over tube sheet .... 16 ft. 6¼ ins.
Smokebox, diameter outside .... 71 ins.
Smokebox, length from tube sheet .... 65½ ins.
Exhaust nozzle, single or double .... Single
Exhaust nozzle, variable or permanent .... Permanent
Exhaust nozzle, diameter ....5 ins., 5 3/16 ins.; 5⅜ ins.
Exhaust nozzle, distance of tip below center of boiler ...... 5 ins.
Netting, wire or plate .... Netting
Netting, size of mesh or perforations 2½-in. by 2½-in. No. 12 wire
Stack, straight or taper .... Taper
Stack, least diameter taper .... 15 ins.
Type of springs .... Triple elliptic
Diameter of wheels .... 36 ins.
Diameter of length of journals .... 5½ by 10 ins.
Distance between centers of journals .... 6 ft. 5 ins.
Diameter of wheel fit on axle .... 6⅞ ins.
Diameter of center of axle .... 5⅞ ins
Length of tender over bumper beams .... 21 ft. 7½ ins.
Length of tank inside .... 20 ft.
Width of tank inside .... 10 ft.
Height of tank, not including collar .... 5 ft. 7¼ ins.
Type of draw-gear .... Williamson & Pries tandem

THE STANDARD BOX CAR.

The Master Car Builders' Association has acted with characteristic promptness in beginning its part in the adoption of the standard box car. Immediately upon receipt of the notice of the adoption of the interior dimensions by the American Railway Association, the President of the Master Car Builders' Association appointed a committee to consider the subject, consisting of Messrs. C. A. Schroyer, Chairman; G. W. Rhodes, W. P. Appleyard, J. N. Barr, Joseph Buker. This committee met in Chicago November 30th, and considered the limiting dimensions of important railroad clearances, the present established height of loading platforms, the various methods of car body construction and proposed the following exterior dimensions for cars of this class:



For a box car set on the trucks used as standard, where the height from top of rail to top of floor is 4 ft.

Height, top of rail to upper edge of eaves .... 12 ft. 6¾ in.

The following details were used to determine the above elevation:

Top of rail to upper face of floor	4 ft.
Upper face of floor to under edge of carline	8 ft.
Width of carline at end where secured to plate	3 13-16 ins.
Thickness of **rafter to which metallic roof is applied**	**1⅜ in.**
Thickness of purlin to which roof boards are secured	1⅛ in.
Thickness of **roof boards**	13-16 in.
	12 ft. 7⅜ ins.
Less pitch of roof from inside edge of plate to outside edge of eaves	⅝ in.
	12 ft. 6¾ ins.

Width, at eaves at above height, maximum .... 9 ft. 7⅜ ins.

The following details were used to determine the above dimensions:

Width, between **lining**	8 ft. 6 ins.
Thickness of lining	1⅜ ins.
Thickness of siding	1⅜ ins.
Thickness of posts and braces	6 ins.
Air space between fascia boards	1 in.
Thickness of fascia boards	1⅜ in.
Projection on each side for roof, ¾ in.	1½ in.
	9 ft. 7⅜ ins.

The **committee believe that these allowances will present no difficulty in framing a car with metallic roofs, as ordinarily applied.** In their circular they recommend not less than 18 ins. as a minimum distance from the top of the rail to the bottom edge of the outside sill. **This was to provide for limits at this point determined by girder bridges and viaducts on many roads.** The circular also suggests the following dimensions:

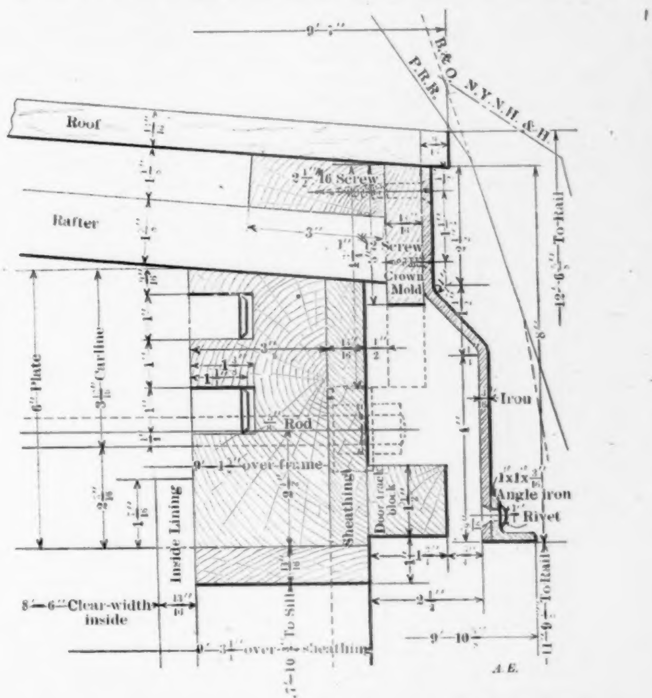
For a box car on low trucks, where the height

from top of rail to top of floor, is .... 3 ft. 6 ins.
Height, top of rail to upper edge of eaves .... 12 ft. ¾ in.
Width, at eaves, at above height, maximum .... 9 ft. 10 ins.

No recommendations are made as to length, but it is the opinion of the committee that the strongest end construction possible should be used, regardless of the exterior longitudinal dimensions.

The subject is placed before the members of the Association by means of this circular, in which replies to the secretary are requested from those who wish the dimensions modified to meet the conditions on their own roads. With this prompt action a definite result may confidently be expected at the June convention of the Master Car Builders' Association.

The principal trouble as to clearances occurs at the eaves, and a diagram furnished us by Mr. John Henney, Superintendent of Motive Power of the New York, New Haven & Hartford, illustrates the construction at this point of cars which



are being built for that road by the Pressed Steel Car Company. In this diagram the full solid line indicates the eaves clearance of the Pennsylvania, the dotted line that of the Baltimore & Ohio, and the dot and dash line that of the New York, New Haven & Hartford. These show the dimensions of cars which will be accepted over all portions of these roads.

Door hoods of metal, pressed into shape, are to be applied in accordance with this drawing. These hoods are brought around on a line with the fascia boards at the ends, and the angle-iron at the bottom extends the full length of the hood. This should give a strong hood, much stiffer than the usual construction, and from the detail drawing it is apparent that wood is out of the question for this purpose.

It has been ascertained that the car shown in the complete clearance diagram can be operated over all of the principal lines east of the Mississippi River, with the exception of a few minor branches, and it is understood that the circular issued by the Master Car Builders' Association giving the proposed limiting dimensions of the heights and widths, is based on this car.

Charles H. Haswell, the first chief engineer of the United States Navy, was appointed in 1836 and was engineer-in-chief from 1844 to 1850. He is now over 90 years of age and was able, last month, to attend the memorable services at the unveiling of the monument erected by the American Society of Mechanical Engineers to the memory of Robert Fulton, in Trinity churchyard, New York. This fact is indeed most impressive of the wonderful progress of engineering in a single generation, when only a few rods away could be found the highest types of merchant and war vessels.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

A fire in our composing room explains the delay in the appearance of this issue. It occurred just as the forms were ready for the press, and we ask the indulgence of our readers for deficiencies which, under the circumstances, could not be avoided.

Roundhouse design now very properly receives an amount of attention which was formerly only given to shops, and the prompt work of locomotive terminals is becoming an important function of the motive power department. Last October we illustrated the general plan of the Collinwood roundhouse of the Lake Shore & Michigan Southern Railway, and in this issue present a number of the interesting details of this terminal as a representative example of the best practice of the time. This plan and equipment very closely covers the ideas as to the "up-to-date" roundhouse which were outlined by the committee on this subject before the Master Mechanics' Association last year, and it is furthermore an example of a plan executed in accordance with the views of the motive power department throughout. An examination of this plan carries the conviction that such an investment as this will earn a high rate of interest to any railroad.

A locomotive coaling plant which actually weighs the coal, and, at the same time, provides for storing it in large chutes with provision for filling the chutes from cars without shoveling, has been greatly needed. In this issue is illustrated a new system which is being installed on a rather large scale on the Chicago & Alton. It not only places the coal in 60-ton chutes, sufficient to take the entire load of the largest coal car in a single chute, but it fills the chutes without shoveling, and also handles ashes and sand in the same plant. In this construction the entire chute and its load is mounted on scales and is weighed by the coal chute attendant, who also does all of the work required about the coaling plant. These scales are housed, which avoids the objection to track scales. A number of roads are putting up coal chutes with one or two large pockets on each side reached by trestle approaches so that 40 or 50-ton hopper cars may be used without a labor charge for handling the coal. The cars are raised on the trestles by switch engines, and the coal dumped by gravity into the pockets from which it is served to the tenders by the usual method. This chute is economical when hopper cars are used, but it has the serious objection of not providing means for weighing the coal. The result is that the individual coal records are not kept with sufficient accuracy to inspire the confidence of the men, and it is impossible to keep a satisfactory record. Without this the most important advantage of the coal record is lost. The construction used on the Chicago & Alton saves the cost and the space required by a trestle, and it also should lead to an immediate reduction of the consumption of fuel, because of the fact that the enginemen see the coal weighed, and if desirable they may be given an autographic record of the weight instead of the usual coal ticket. Because of the vital necessity of the best possible equipment of locomotive terminals and other coaling stations along the road, the design appears to be an attractive and important one.

In the operation of heavy locomotives attention is attracted as it never has been before to the necessity for improved side-track facilities. With a long, heavily-loaded train, it becomes desirable to reduce the number of stops to the minimum, and with the present demand for the utmost possible use to be obtained from locomotives all time lost on the road is expensive, not to mention the cost of delays which involve overtime for the train crews. For either double or single-track roads, with fast-time freights or stock trains and passenger trains using the same tracks, "lap sidings" offer advantages which do not appear to be fully appreciated. The superintendent of motive power of an important Western road having these conditions says: "I wish you would urge upon your readers the use of the 'lap siding,' so that these large engines with heavy trains can run to them, and the dispatcher would know that they were making meeting points. At the end of each of these sidings, which may be from 1 to 4 miles in length, there should be an operator. His duty should be to give the enginemen the signals and throw the switches for them. Then the trains may come along at 20 miles an hour, which would help the coal bills and greatly assist the movement of trains. It would also save the draft gear of cars and avoid the serious delays which are frequently caused by break-in-twos in pulling out of sidings. The value of these facilities to the train dispatcher can hardly be estimated. By a careful study of this idea I believe we could get along with fewer side-tracks and yet do the work more economically."

The Pennsylvania Railroad plan for its terminus in New York City is bold and comprehensive beyond precedent. It combines a number of elements, a single one of which would, a few years ago, have been ridiculed. The Long Island and Pennsylvania will meet in an underground station 1,500 ft. long by 520 ft. wide, situated between 31st and 33d streets and 7th and 10th avenues, this station to be reached by tunnels under the North and East rivers. Connection will be made with the Rapid Transit Subway at 4th avenue and through trains of the Pennsylvania, as well as suburban trains of the Long Island, will come into the heart of the city without change. With electricity as a motive power this plan will undoubtedly exert a great influence on the future of similar transportation problems, and the scheme, as a whole, seems likely to revolutionize methods of managing the terminal problems of large cities. In all respects the plans are worthy of the great railroad by which they are undertaken. A work of this extent is sure to present engineering difficulties from its very size, but added to these is that of supporting a tunnel in the soft material forming the bed of the North River. That this can be overcome is assured by those who are conducting the undertaking and the development of the plans will be watched with an interest never before given to a work of this character. The franchise has not yet been granted, but as the tunnels will run under the streets and deep enough to avoid endangering foundations, there seems to be no reason to expect the least opposition; private land will not be affected. Speculation as to the future steps which will be made possible by this terminal is interesting, but the scheme as outlined is sufficiently large for present contemplation.

Nobody wants additional complication in locomotives, and nobody wants the crank axle. If, however, there is any considerable gain to be had from a divided engine with four cylinders and a balanced arrangement, which of necessity involves both of these undesirable features, they are likely, eventually, to be accepted. There are many theoretical advantages offered for the four-cylinder compound which seem to meet the present need, and this system has been so successful in practice as to justify a thorough, practical investigation of the principles as applied to our conditions. The American Engineer does not advocate greater complication, and it does not urge the crank axle, but it unhesitatingly takes the ground that the four-cylinder balanced compound should be thoroughly exploited in this country, in order to ascertain the truth with respect to the claims of the type, and if the expectations are realized there need be no fear as to the management of the details.

In this issue is illustrated an interesting adaptation to American ideas of the principles of the engines first brought out by Mr. Alfred G. de Glehn in 1886 in France, which have been so successful in Europe. The de Glehn compounds have placed French passenger service, in point of high-speed trains, above that of every other country, including ours, and the trains are by no means light. Their remarkable acceleration has impressed everyone who has investigated the subject carefully. These engines are far too complicated for Americans, but Mr. Muchnic suggests an adaptation which reduces the number of additional parts to a very few.

In the de Glehn compounds the inside (high or low pressure) cylinders are placed at the forward end of the locomotive, driving the crank axle, which is the forward axle of the 8-wheel, 10-wheel and Atlantic types, and the second axle of the consolidation type. The outside (high or low pressure) cylinders are placed outside the frames and in the rear of the others, being as near as possible to the foremost pair of wheels for sufficient clearance between the cylinders and the wheel flanges. The outside cylinders drive the second or third pair of driving wheels. Each cylinder has a separate valve and valve motion, with the ordinary slide valves. An intercepting valve is placed between each pair of cylinders, in order to work all four cylinders with live steam when necessary.

For Mr. Muchnic's plan the reader is referred to the description. He suggests two valves and two ordinary valve gears. The additional complication then becomes a question of rods and the crank axle. As to the rods it may be said that for large engines of the prevailing types the main rods have become so heavy as to be troublesome in the shop. For this reason, and because of the enormous stresses from the large pistons of modern engines, it seems probable that the relief obtained by a division of the work among a larger number of rods will be important. Preparations are now being made to investigate these principles in this country, and it is to be hoped that the experiments will be painstaking and thorough.

In following the records of recent locomotive development in this country, as outlined by Mr. F. J. Cole in his paper before the New York Railroad Club last November, and in the remarkable prairie type engines just put into service on the Atchison, Topeka & Santa Fe, the impression cannot be avoided that the advance in locomotives has outstripped that of the roadway and its structures. This leads to the conclusion that it is necessary to look to those features of locomotive design which tend toward increasing to the utmost the effectiveness of every pound of weight. In an able article in the "Railroad Gazette" of September 27, 1901, Mr. F. F. Gaines, Mechanical Engineer of the Lehigh Valley, presented some important observations in this connection, and in our issue of October the same subject was reviewed.

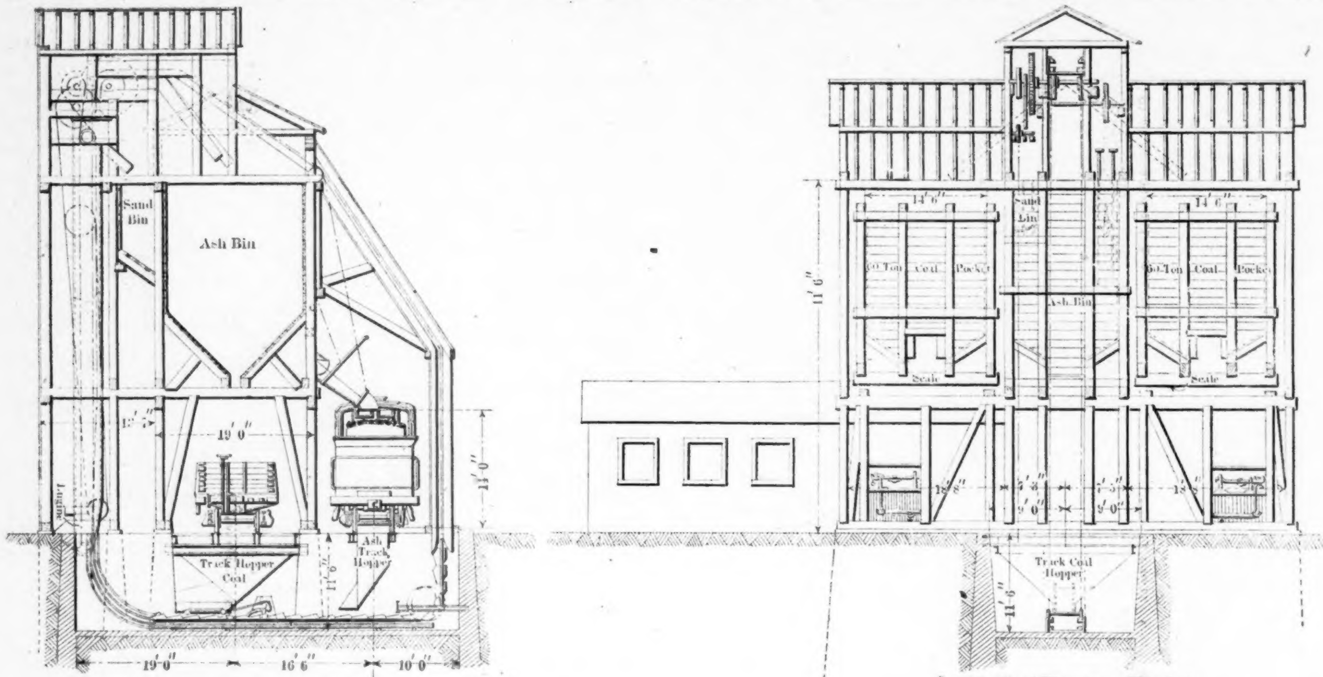
The fact that a leading Western road applied to the editor of this journal for special apprentices was announced in these columns last month, and the responses are suggestive and interesting. A well-known professor in a technical school was one of the first to reply. He believes that the railroads deprive themselves of the best material for successful mechanical officers by the low wages offered to apprentices, and while firmly believing in the spirit of willingness to accept low salaries while learning one's work, he finds it difficult to induce graduates to refuse positions paying from $60 to $70 per month in order to take apprenticeships. The deluge of applications from students who are about to graduate and want to know about this particular opportunity is, however, encouraging. There is no greater menace to the successful career of a young engineer than the feeling that he is wanted for an important position, and that he can step into one immediately after graduating. At that critical period it is usually positively dangerous for him to feel that he has the choice among a number of good positions. We would like to see educators and others urge boys to seek opportunities to learn and to prepare for the good things later, because of thorough preparation in low positions. They should be led to forget the matter of salary until they have something which is really worth a good salary. We have in our editorial rooms a long list of names of disappointed, discontented technical school graduates to prove that a good start as to salary often means a long and unsatisfactory pause in progress a little later on. Those who ignore the compensation and forget that their education is expected to accelerate their advancement are the ones who reach the higher places.

Mr. Clarence P. Day, after eighteen years' experience in connection with advertising departments of leading technical publications, has resigned as Vice-President of the Industrial Press, a position which he has filled for several years, to undertake a unique service for mechanical advertisers—that of Advertising Counselor. The intimate knowledge of the subject of advertising gained in his exceptional experience will be made available to those who desire to obtain the best possible results and greatest effectiveness of their advertising. Mr. Day has a field of his own, and is not in any sense a broker or agent. He institutes a new profession as a student of advertising, and an adviser to produce higher efficiency in mechanical advertising. One of the tendencies of the times is toward discrimination in advertising, and there is a widely-felt need for the services which Mr. Day will give. The client pays for the service and the scheme positively excludes commissions or other renumerations of all descriptions. Here is one who thoroughly understands not only the advertising problem, but the possibilities, methods and means. He is a competent specialist who, from a life study of his subject, is prepared to give expert professional advice with original and detailed plans which are sure to raise the standard of advertising. Mr. Day's plan seems to us most sensible, comprehensive and effective. His pamphlet, "Higher Efficiences and Economy in Mechanical Advertising," we endorse, because it contains the real secret of results. His enterprise will have the cordial support of honest publications in his field. Mr. Day's address is 263 Broadway, New York.

LABOR-SAVING COAL CHUTES.

Chicago & Alton Railway.

The construction of chutes for coaling locomotives seems to be tending toward larger pockets with sufficient capacity to receive the entire contents of a 40 or 50-ton car. A number of chutes of this size are being built in such a way as to save, altogether, the expense of labor in handling the coal because of its being dropped by gravity directly from the car into the delivery chute. By providing an inclined plane to elevate the cars, one man, with the aid of a gasoline engine, can operate the coaling plant. These chutes are very satisfactory in every particular but one. They do not provide means for keeping accurate accounts of the individual coal records of the locomotives. This is a serious defect, and the time has come when we have no hesitation whatever in stating plainly that no method of accounting for coal which does not provide for taking its actual weight can be satisfactory. It is impossible to get men to take the proper interest in their coal records unless they are satisfied with the method of keeping the accounts. This cannot be done in any other way. For this reason the new chutes which are being installed on the Chicago & Alton are specially interesting. They combine the large chute holding an entire carload of coal with the weighing apparatus, and they also include ash and sand handling facilities.



Section Through Pockets

Longitudinal Elevation of Pockets
Pit and top of Building in section

Labor-Saving Coal Chutes—Chicago & Alton Railway.

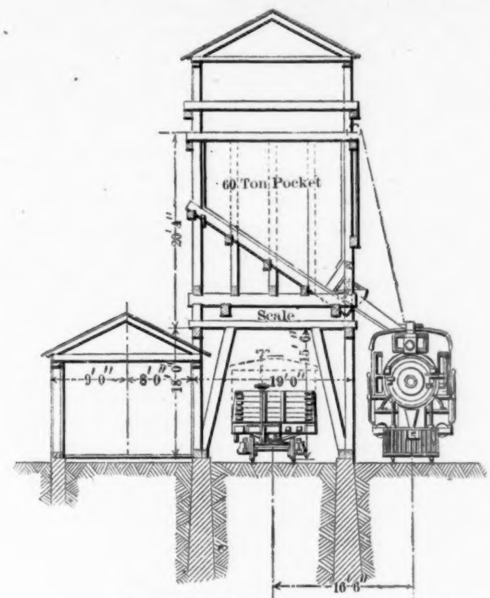
Ten of the most improved chutes have been contracted for by the Chicago & Alton Railroad. These will be at Kansas City, Slater, Vanice, Roodhouse, Bloomington, Farber, Tallula, Ridgley, Odessa and Virden. The accompanying plan shows in a general way the principal features of all of these plants, but there are variations in the details at various places. For example, the first four are operated by steam engines. The Farber, Tallula, Ridgley, Odessa and Virden plants will have gasoline engines of 15 horse-power each, furnished by the Otto Gas Engine Works through Mr. T. W. Snow, of Chicago. At Bloomington the company has electric power distribution at the shops, and this plant will be run by an electric motor. The first five are at terminals, while all the others are on the main line and are for use by the locomotives as they pass by. Where it has been possible to do so the water cranes are located at the chutes, in order to avoid the necessity for making another stop for water. In such cases, if the water is pumped, the pump is driven by the gasoline engine. As a rule these plants are operated by one man, and the labor charges are exceedingly low.

In the plan view the general arrangement is indicated. This includes two 60-ton pockets on scales, an ash bin, a sand bin, a sand storage building, sand drier, coal and ash elevator and a separate sand elevator. In the corner of the plan a storage pocket for 300 tons of coal is shown. This may be installed at any of the plants. This storage is served by the conveyor, both in filling and discharging. It provides for keeping 300 tons at hand, which may be drawn upon at any time without shoveling.

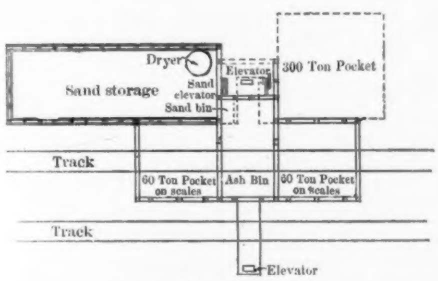
Coal cars are brought into the structure and the coal dropped into the track hopper. It is carried to the coal chute by the conveyor and from here it may be delivered to locomotives. The entire pocket is mounted on scales which have two beams. Before coaling a locomotive the pocket is balanced by the upper beam. When the tender is filled it is again balanced, but by the lower beam, which gives at once the weight of the coal discharged. This may be made to give an autographic record in duplicate for the engineer and the coal chute attendant. An admirable coal valve is employed at the tender chute. It is in the form of a portion of a cylindrical shell, which cuts up into the stream of coal in closing and for this reason cannot become clogged by lumps.

As an engine is taking coal the ash pan is over the ash-track hopper, and the ashes may be dumped into it. This hopper is in a pit 11 ft. 6 ins. deep, and will hold the ashes from a number of engines. Coal and ashes are handled by the same elevator, and when the elevated ash pocket is full it is dumped into a car without shoveling. Of course, these elements admit of a number of combinations, but all of them provide for reducing the necessary labor to a minimum. Other methods of weighing chutes have been proposed. In one of these the chute is hung on rods, which are deflected out of the vertical in such a way as to bring the chute against a measuring device which records the horizontal thrust of the load due to the angularity of the support. This plan was worked out on the Northern Pacific, but its use has not extended, probably because of a lack of sensitiveness of the weighing and a difficulty of inaccuracy when the chutes are only partly filled. By placing the entire chute on scales, large scales are required, but the results are sure to be accurate. In this construction the scales are housed and sheltered, which takes them out of the class of track scales.

This work on the Chicago & Alton is being done under contract in connection with water station improvements. It is attracting considerable attention among railroad men who are anxious to improve their fuel records. The starting point in this direction is accurate knowledge of the amounts of coal delivered. It is also important to reduce the cost of handling the



Section Through Pockets on Scales. A.E.



Plan of Buildings. A.E.

Coal Chute—Chicago & Alton Railway.

coal by labor-saving methods. It is obvious that in such plants as these this cost will be very low.

Working loads for manila rope is a subject upon which there are comparatively little data. In a paper before the American Society of Mechanical Engineers Mr. C. W. Hunt discussed the features concerning loads for hoisting purposes. He gave data in definite and satisfactory terms and presented the results of experiments and also of his wide experience. The tables of the paper include working loads for ropes of various sizes, the minimum diameter of sheaves for various speeds and the ultimate strength of different sizes of rope.

Already more perfectly balanced high-speed engines are demanded, and successful efforts to reduce the weights of the reciprocating parts are noticed in many new designs. Whether this move will take the form of gradually introducing four-cylinder, balanced engines of the De Gheln type, which are running so successfully in France, remains to be seen. Perhaps we are not quite ready at the present time for the added complication of crank axle, extra rods and cross heads; but the fact remains that every effort will be made in the future to reduce, as much as possible, the dynamic weight of the future high-speed engine.—F. J. Cole before the November meeting of the New York Railroad Club.

SOME RUDIMENTARY CONSIDERATIONS CONCERNING THE TREATMENT OF WATER FOR LOCOMOTIVE USE.

By R. P. C. Sanderson,

Superintendent Motive Power, Atlantic Coast Line.

A prominent general manager, when recently directing the attention of motive-power men to lines of usefulness, gave special prominence to the matter of water treatment for boiler use. (J. Kruttschnitt, in "American Engineer," June, 1901, page 170.) It must be a singularly unobservant mechanical officer who can visit boiler shops daily, see fireboxes and flues coming out of the engines on account of scale, cracks, bulges, leaks, etc., who can review the daily failure reports on a bad-water road and not be inspired or driven to do something toward improving the water service.

On very many railroads the water supply is not in the hands of the motive-power department, the division superintendents or engineering departments being held responsible for the water supply, and money expended for this account. As it often happens these officers are men who have been raised on the road, have always heard of the bad water, and feel the indifference bred of long familiarity for the troubles due to the bad quality of the water. As they are directly personally responsible for their division expenditures, and have to make a comparison monthly and yearly for all their maintenance charges, they are reluctant to spend money which will bring them no return, but the benefit for which expenditure will be felt by another department. The general manager, whose duty it should be to order such expenditures, is also often reluctant to spend money on improved water supply, because he has seen so many failures of ill-advised efforts to treat water, and the mechanical officer is unable to tell him what return he can promise for the money to be spent. It is, furthermore, impossible to figure out the saving per engine-mile or ton-mile for some improved water service in advance, as a justification for a proposed outlay.

As a result of painstaking study, and some considerable experience in improving the water supply, both East and West, the following may be of service to mechanical officers and others who are obliged to face this problem without having had opportunities to study the questions involved.

The first thing to do is to have analyses made of all the waters that are to be considered for treatment. These analyses should be checked, and repeated under different conditions of weather, drought, etc., as the quantities of the salts in solution, and matter in suspension, will vary greatly under different weather conditions. Having then learned which water supplies are the worst, it is important to ascertain the quantities used from each source, as there is no justification for spending large sums for bettering a supply that is very little used or is likely to be abandoned in the course of time on account of its inconvenient location. There are two main sub-divisions under which water impurities can be classed.

First, matter in suspension—mud, sand, sewage, etc. Second, matter in solution—principally the salts of soda, lime and magnesia. The first can be readily treated by filtration; the latter cannot be improved in this way.

River waters very generally contain matter in suspension as well as in solution, so that when considering a muddy water, samples should be taken under different conditions of muddiness, carefully filtered, and the remaining water analyzed to see if, after filtration, the water will be fit for boiler use. It would be disappointing to put in an expensive plant for filtration, and find out afterward that the filtered water was too bad for economical use.

When filtration is clearly indicated as necessary the problem is generally a simple one, and must depend on local conditions to some extent. Either settling ponds, or tanks of sufficiently large capacity, can be used and the cleared water drawn off through a natural or artificial sand bed, or one of the improved mechanical filters may be found to be the most economical where the filtration is done under pressure. The first plan usually requires the larger first cost, and is sometimes not practicable for lack of space. The latter requires more attendance, but when intelligently applied and handled is perhaps even more effective.

Matter in Solution.

When we come to consider waters that have excess of lime and soda salts in solution we face a far more difficult problem. Without attempting to go into the chemistry of the matter in detail, or yet pretend to accuracy, speaking generally, the principal troubles from hard water, as such water is called, are due to the salts of lime and soda; the potassium, lithium and magnesium salts are often present, but generally in smaller quantities, and of less consequence.

The salts referred to are, generally:

Lime Salts.	Soda Salts.
Carbonate of Lime,	Carbonate of soda,
Sulphate of lime.	Bicarbonate of soda,
	Sulphate of soda,
	Chloride of soda.

Others are found, but not so frequently, and in minor quantities. The lime salts generally are given up by the water to a large extent when heated; the soda salts are more soluble in hot water than in cold. The lime salts cause most of the scale troubles in boilers; the soda and magnesium salts cause most of the trouble from foaming, pitting and corrosion.

The lime salts can be got rid of largely by heating the water beforehand and filtering or allowing the deposits time to settle, but the amount of fuel needed to do this, as well as the cost of the plant and attendance required, is usually prohibitive. The lime salts are deposited when the water is heated because, the chemists tell us, they are soluble (except in small quantities) only in water that contains carbonic-acid gas in solution; when this gas is driven out of the water by heat the water will no longer retain the lime salts in solution. Generally the carbonic acid and sulphuric acid which is in the carbonate and sulphate of lime has a stronger affinity for the soda than for the lime; consequently it is possible, by adding soda, in the shape of soda ash, to waters containing too much lime salts, to change the nature of the salts. The phosphate of soda treatments are also based on this principle, but it must be clearly remembered that the matter in solution cannot be obliterated; it is still there in some other form, and if the water under consideration is already heavily charged with soda salts as well as lime salts, it is generally unwise to attempt to treat the lime salts by adding still more soda.

Owing to the property of hot water of carrying more soda salts than cold, the amount of salts of soda in a boiler will go on increasing until the solution becomes so heavy and dense that it cannot properly give off steam in boiling, and foams like soap suds. Adding soda salts to water to treat the lime salts helps to produce this condition. In addition to the trouble from foaming there is the corrosion and pitting to reckon with. Just what the chemical actions are that take place in a high-pressure steam boiler while water containing soda or magnesia salts are being evaporated is conjectural, for under the nature of things no investigation can well be made. It is understood that there are changes which liberate the acids and these attack and eat the boiler sheets and tubes. It is considered wise in some cases to add lime to such water, with the idea that the free lime in the water will combine with the acids and save the steel from attack. It is further certain that a thin coating of lime salts is a protection against such corrosion.

Attention is further directed to the bicarbonate of soda which is often present in artesian waters, although it has to be especially searched for in the analyses or it will be classed as carbonate of soda. When water containing bicarbonate of soda is heated in a boiler one part of the carbonic acid gas is given off, causing violent foaming, still leaving the carbonate of soda in solution. This can be remedied somewhat by adding lime, which can take up the extra carbonic acid from the carbonate and leave the carbonate of soda and carbonate of lime, avoiding some of the foaming troubles. The magnesia salts are also corrosive, and the causes are supposed to be the same as for the soda salts.

No attempt is made here to go into the chemistry of the water treatments referred to; simply the salient points are sought to be made clear. Those having no knowledge of chemistry would not understand such an exposition, and those who are chemists know more about it than the writer. When chemical treatment of waters is indicated to be necessary the matter should be placed in the hands of a competent chemist, if the road does not employ one, and his recommendation should govern. Generally it will pay better in the end to go far afield to get a good supply than to try to doctor a bad one.

One thing is certain above all others, a locomotive boiler strained to the utmost to furnish steam is not the proper place to be carrying on chemical processes for purifying the water, which it is busy evaporating; this should be done at the water stations before the water is put in the tenders.

There are still other methods of water doctoring that have given good results under certain conditions; they are by the use of tannins or bark extracts or gums and by certain specially adapted oils; the theory of the use of these is not to change the nature of the waters, but to prevent the scale particles from sticking together and forming a hard skin, by making them settle in the form of soft sludge which can be washed out or blown off at intervals, instead of burning upon the sheets and tubes. Indeed, some of the materials used will actually cause old scale to be detached and come down to the bottom of the boiler. It is, however, important that the quantities of these materials should be carefully regulated to the amount of matter contained in the water, and this is very difficult to govern in service where crews are pooled and engines changed from division to division, using water of widely different characters.

It is hoped that this general discussion will be of service to those who are responsible for the water supply of railroads and will enable them to take up these matters more intelligently, and prevent them from being misled into expensive experiments on lines which are foredoomed to failure for lack of general knowledge of the underlying principles involved.

CORRESPONDENCE.

WHY AIR BRAKES SHOULD BE IN CHARGE OF A RESPONSIBLE OFFICER.

Editor American Engineer:

From time to time correspondents of your valuable and interesting paper have invaded its columns with pleas and recommendations for better air-brake maintenance, and also for the establishment on the various lines of railways of an efficient air-brake department, placed in charge of a competent air-brake inspector or superintendent. That there are good reasons and grounds for complaint with regard to the condition of air brakes on almost every large railway system is generally admitted by everybody, and it does not require any proofs to be brought forward to reinforce the statement or to make it carry weight.

During the past year the Air Brake Association has endeavored, by suggesting ways and means to the proper officers in authority, to improve the air-brake service on all roads, and to stand for better maintenance of the air-brake apparatus, especially on the freight equipment. At a meeting of the New York Railroad Club, recently held in New York City, a paper was read by one of the prominent air-brake experts which dealt with the air-brake problem as it should be handled by the officers—the higher officers—of a railroad. In this paper the importance of the superintendent of air brakes is clearly demonstrated, and his place among the other officials of a railway properly marked out. The ways in which he can save his salary many times over to the railroad company are brought out so clearly that it must indeed be a very dull general manager who cannot perceive the economy in placing in charge of the air brakes on his road a good, bright, competent air-brake inspector, giving him full control of the air brake and holding him responsible for the results obtained in the air-brake practice on his road.

Some very wise suggestions were made in this paper relative to the standing of the air-brake superintendent and to whom he should report, but from the facts there presented it was thoroughly demonstrated that the best showing was made by the air-brake inspector who enjoyed the personal backing and support of the general manager, and who reported directly to that officer.

So important has the question of air-brake maintenance become that the average superintendent of motive power or master mechanic is not able to give it the necessary amount of attention, and he does not possess the technical knowledge of the air-brake apparatus, nor the knowledge of the action of brakes under varying conditions of service which a person should have who is to manage the air-brake department. It would, therefore, be a marked improvement in railroad management if this important branch of the business was placed entirely in the hands of a man thoroughly qualified to take charge of it, who could devote his whole attention to it, and whose orders and instructions relative to the air brake should be carried out to the letter.

In the paper referred to, instances were cited of serious wrecks which occurred, costing thousands of dollars, simply because some seemingly unimportant matter in connection with the air brake was neglected before the train departed from the terminal. Nearly a year ago a collision occurred between a passenger train, on which I was riding, and a freight train, which would not have occurred had the brakes on the passenger train been in even fairly efficient condition. The train consisted of two engines, double heading, and six passenger coaches. There were no brakes whatever applied to the engine trucks, and of the passenger coaches, three were of the six-wheeled truck variety, having brakes applied to only two pairs of wheels in each truck. Several of the coaches had recently been put through the shop and had heavy vestibules put on them, thus increasing their weight, but no additional braking force was provided to hold them during brake applications. One of the cars, a diner, weighed 97,000 lbs., and had only a 10-in. brake cylinder to supply pressure to the foundation brake gear, when it should have a 14-in. brake cylinder, which its weight called for. The total weight of the engines and train and load was a little over 899,400 lbs. As this train approached a distant semaphore signal located about 2,900 ft. from the home signal, under which the freight train was standing with which it collided, the engineer closed the throttle of his engine and applied the brake, as he stated, with a full application, but the train could not be stopped in time to avoid a collision. Although the collision resulted in damage to the three engines, without hurting the passengers or damaging the coaches, yet it was possible for it to have been disastrous in its consequences.

The rate of speed of the passenger train at the instant of passing the distant signal as nearly as could be determined was fifty-four miles per hour, possibly a little higher than this—a little more than 79 ft. per second—and the distance in which to stop without collision was about 3,000 ft. The braking force of the whole train, carefully calculated, did not aggregate 45 per cent. of the weight of the train. Of course, when all these facts were brought out, there was nothing surprising in the fact that the train could not be stopped in the distance allowed. To further delay and weaken the action of the brakes, the piping on the engines was excessively crooked, and contained numerous elbows; so many, in fact, that quick action of the brakes was impossible to obtain from the leading engine.

Right here in connection with the matter of obtaining quick action through two engines that are double heading, it may be interesting to note what Mr. J. W. Thomas, Jr., General Manager of the Nashville, Chattanooga & St. Louis Railroad, had to say at the meeting referred to regarding this matter. He said: "Some time ago, in making tests to demonstrate the fact that an emergency application could be got through the second engine if said engine was properly piped, we failed to get an emergency application. Upon investigation we found the triple valve strainer under a tramp sleeper which was placed next to the engine so stopped up that it required at least ten minutes to charge the reservoir."

After the accident the usual remedy of dismissing the engineer was applied, although he stated—and it could easily be proved—that he applied the brake immediately after passing under the distant signal, 2,900 ft. from the point where the engines collided, and he also stated that that was the first occasion he had had to use the brakes since making the test application at the terminal which he had left only ten or fifteen minutes before.

Here is an instance in which, had an air-brake inspector been allowed to take charge, and had been clothed with sufficient authority to enforce his instructions and orders, he could have saved the company a large sum of money and also the situation of the engineer, and there could have been no question of efficiency of the brakes.

In the course of his remarks before the New York Railroad Club Mr. Thomas said: "But what about the brakes which are not maintained? Is it because we wish to economize? If so, is it not a bad idea to cut down along this line? I am inclined to believe our neglect in this direction arises from the fact the conditions are so variable that it is impossible for us to arrive at even an approximate estimate of the result of our failure to keep the apparatus in good shape. The engine and train crews and a few inspectors realize more fully than the majority of us what poor brakes mean, but if they complain the subject is generally dismissed by saying that the brakes should have been applied sooner."

Such matters as block signals, air brakes, electric headlights, etc., require the services of specialists to keep them at their highest efficiency, and it would seem that the sooner the railroad companies recognize this fact and place competent men in charge of these departments the better it will be for all concerned.

J. P. KELLY,
New York Air Brake Co.

SAND DRYING.

To the Editor:

I noticed an article in your October number, on sand driers, by the Chicago, Milwaukee & St. Paul, and as I believe that they were right in abandoning the hopper stove, I also believe that the rotary drier will not solve the whole problem. They are adopting a drier that is used to dry ore at many mines in the West to dry sand, and this can be done. But the first cost of such a plant is large. There is the machinery to revolve the cylinder, to handle the wet sand, to remove the dry sand, the fire to keep up, and it is necessary to always have a uniform temperature or the sand will not be uniformly dried. The cost of operation is an additional difficulty.

These things have made railroad men desire a more economical machine to install, to operate and to maintain. After some ten years of experience in the maintenance of way department of a railroad, where the drying of sand with hopper stoves was a large factor at times, I feel confident the sand drying departments of all our railroads could be remodelled and brought to a higher degree of efficiency and economy. The old hopper stove must go. It has served its day and generation well. That has been apparent for some time; but the appliance to put in its place was not forthcoming. Only of late has one appeared.

A great many experiments have been tried to dry sand by steam, but they were greater or less failures. The method of doing the work was not right. The steam was not to blame; it was the poor application of it. As to the ability of drying sand thoroughly by steam at a temperature of 212 degrees there is no question. A greater heat would drive off the water of crystallization and ruin the quartz for grit purposes. That was one great objection to the hopper stove. The sand next to the hot stove was burnt and formed paste under the wheels instead of grit.

In my judgment, steam drying will prove the easiest to handle and to apply, as well as the most economical. Steam is not only doing good work drying the crushed stone (sand) for the Pennsylvania Railroad Company at Pittsburgh, but it is doing equally as well on common bank sand for the D., L. & W. R. R. Co. at Scranton, Pa. These driers I believe to be the best yet in service, as they dry thoroughly from forty to fifty tons of sand every ten hours and have but one attendant.

A. D. BLACKINTON.

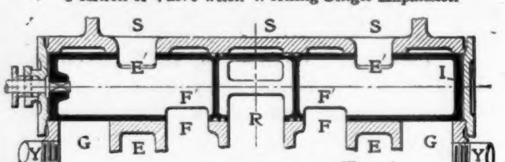
FOUR-CYLINDER BALANCED COMPOUND LOCOMOTIVE.

A Design by Charles M. Muchnic.

Mechanical Engineer, Wisconsin Central Railway.

The object of the designer of the four-cylinder compound illustrated by these engravings was to produce a compound locomotive of the divided balanced type, based on the principles of the successful de Glehn compounds, and embodying their chief characteristics in an application in accordance with valve chamber, V, and an intercepting valve chamber, K. The inside high-pressure cylinder is inclined so that the inside connecting rod clears the forward axle. In the 8-wheel or any other design where the distance between the cylinder and the forward axle is sufficiently long to allow the use of a connecting rod of a proper ratio to the crank, the inside cylinders can be made horizontal, and on the same plane with the outside low-pressure cylinders. The horizontal and vertical center lines of the outside low-pressure cylinders are the same as in the usual simple expansion locomotives; the same may be said with regard to the cylinder frame fastening, top flange adja-

Position of Valve when Working Single Expansion



Section C-H-K Fig. 4

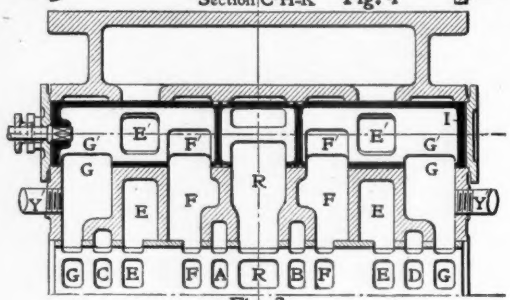


Fig. 3

Section A-B-C-D-E

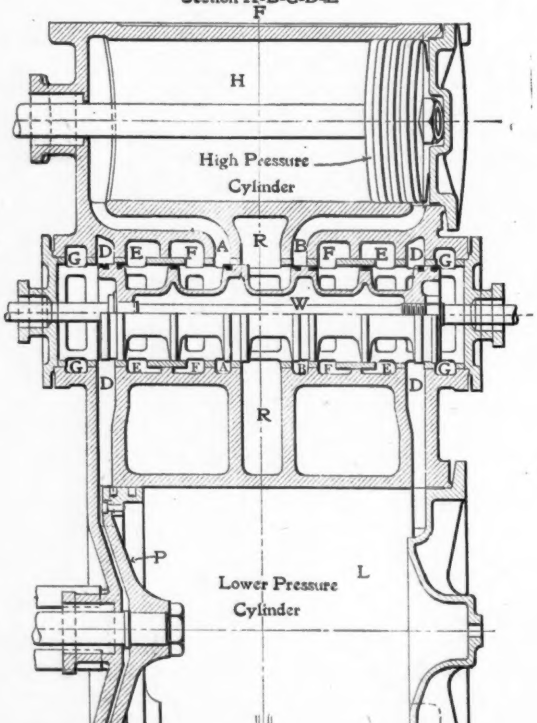


Fig. 2

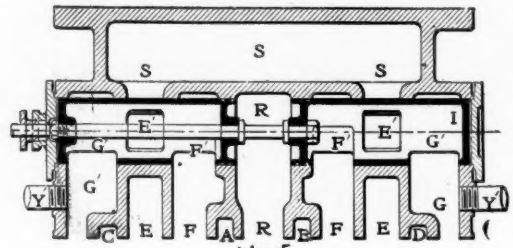


Fig. 5

Section F-G

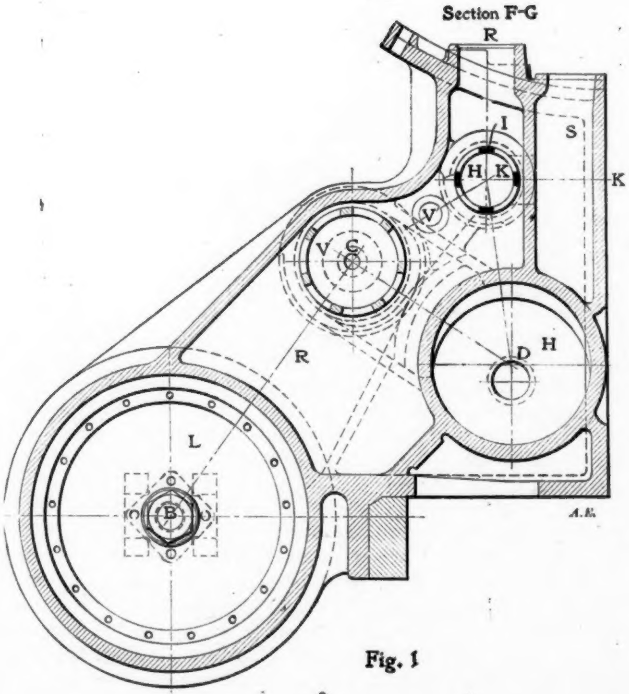


Fig. 1

the ideas of simplicity which characterize American practice. As yet the design has not gone beyond the drawing stage. The ideas involved represent a careful study of the successful compounds abroad—combined with knowledge of American locomotive practice.

Cylinders.—Fig. 1 shows a section through the main steam admission and exhaust passages. Each half saddle includes one high and one low-pressure cylinder for each side, a common cent to boiler, position of main steam and exhaust passages or height of saddle. In fact, the general design of the cylinder saddle, in construction, outward appearance or its relation to the frames, boiler or smokebox appliances deviates in no way from the usual modern simple half-cylinder saddle. It is possible, therefore, to substitute this compound cylinder structure for the usual simple cylinder casting without any alteration in the adjacent parts. This can be seen at a glance from reference to Figs. 6 and 7, which show these cylinder saddles applied, as a study, to a well-known American locomotive, and in which no other alteration has been made, except for the substitution of the compound cylinder casting in place of the simple cylinder castings and the addition of their running gear. (In order to work out this design in connection with an actual locomotive Mr. Muchnic selected the Class H 6, consolidation locomotive of the Pennsylvania Railroad as a representative 8-coupled engine, and took the dimensions from the engravings of that engine which were printed on page 177 of the June issue of the American Engineer and Railroad Journal of 1899. It is to be understood that this was done as a study and without the knowledge of the officers of the Pennsylvania Railroad.) Fig. 2 shows a section through the cylinder half-saddle, Fig. 1, and on line A, B, C, D, E, as well as of the single piston valve for both high and low-pressure cylinders in its position.

Piston Valve.—This valve, W, Fig. 2, of the closed piston type, is a single hollow casting, through which the valve rod passes, having a shoulder or collar on its rear end and a nut on the front end; this valve rod extends through the front

pound into simple and vice-versa. Its control can be manual or by power; in both cases it is manipulated from the cab.

Application.—An elevation and partial plan of the consolidation locomotive referred to with this principle applied are shown in Figs. 6 and 7, which also present a table of the principal data. In this engine the general design has not been altered, as has been already remarked, except for the substitution of the compound cylinder saddles for the simple, a crank axle for the plain one and an addition of a pair of inside rods and guides.

Operation.—The working of this compound system will be readily understood. The piston valve, W, Fig. 2, has moved forward from its central position to uncover the high-pressure steam port, B, through which live steam from the boiler, coming by way of the main steam passage, R (see Figs. 1 and 2), passes into the high-pressure cylinder, H, and pushes the piston, O, to the left. At this movement the volume of steam contained from the previous stroke in the high-pressure cylinder, H, is being exhausted through steam port A into the high-pressure exhaust passage, F, thence through the intercep-

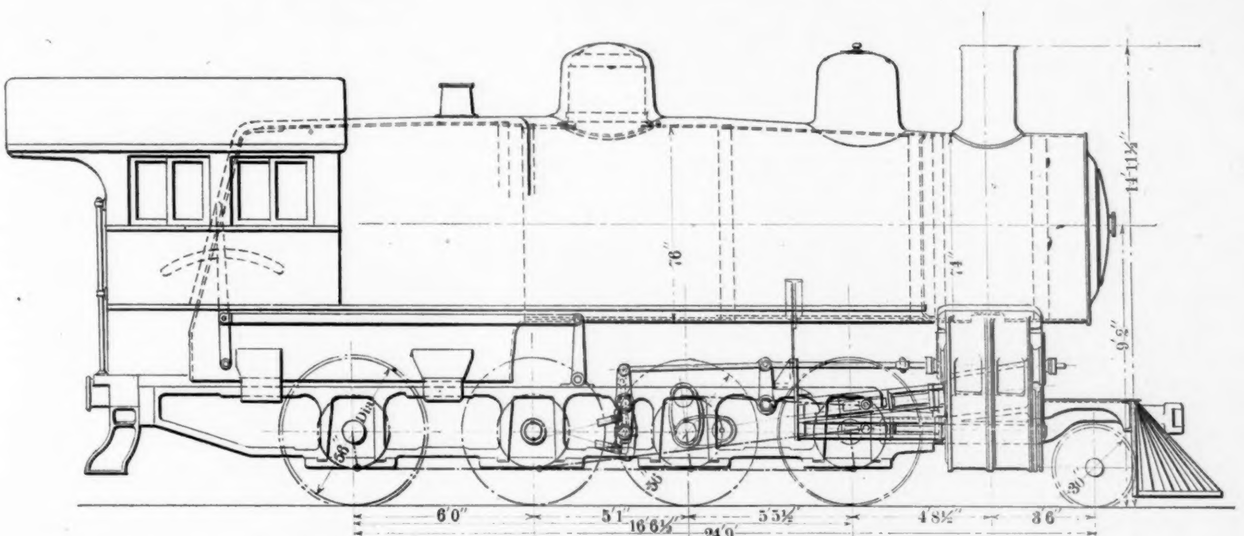


Fig. 6

Cylinders	16" x 28" / 28"
Ratio of Cylinder Volumes	1:3.06
Boiler Steam Pressure	200 Lbs.
Heating Surface	2917 Sq. Ft.
Grate Area	33.3 Sq. Ft.
Weight on Drivers	158000 Lbs.
Total Weight, Working Order	190000 Lbs.
Adhesive Weight .25 of Weight on Drivers	41000 Lbs.

Tractive Force, Working Compound =

$$F = \frac{1.6 \times P \times D_L^2 \times S}{D \times (R+1)} = \frac{1.6 \times 200 \times 28^3}{56 \times .406} = 30896 \text{ Lbs.}$$

Working Simple =

$$F = \frac{1.6 \times P \times D_H^2 \times S}{D} = \frac{1.6 \times 200 \times 16^2 \times 28}{56} = 40961 \text{ Lbs.}$$

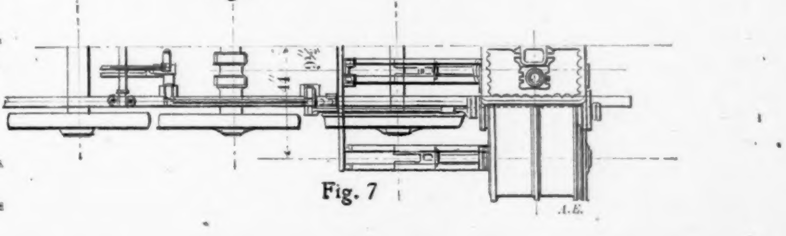


Fig. 7

steam chest cover. The valve is double and controls the admission and exhaust of steam in both high and low-pressure cylinders—being of the internal admission type for the high-pressure cylinder and external admission for the low-pressure cylinder. Its construction is very strong and extremely simple.

Intercepting Valve.—Figs. 3 and 4 show sections through the steam chest and intercepting valve chamber, K, Fig. 1, and on lines C, H, K, also sections of the intercepting valve I. In Fig. 3 the position of the intercepting valve I is normal; that is, when the engine is working compound. In Fig. 4 the position of the intercepting valve, as shown, is when operating all four cylinders in simple expansion—on live steam from the boiler. This intercepting valve is simply a three-way plug and can be made in either one or two sections, as shown in Fig. 5. It serves the purpose, as will be explained further, to direct the high-pressure exhaust steam either to the low-pressure cylinder, when operating compound, or to the atmosphere when working all cylinders in simple expansion—on live steam from the boiler. The valve turns on its axis, and a quarter turn will change the working of the engine from com-

ting valve openings, F^1 and G^1, Fig. 3, and passes into the rear end of the steam chest. It will be noted in Fig. 2 that the displacement of the valve, W, from its central position forward has increased simultaneously with the high-pressure cylinder steam port, B, also the low-pressure cylinder steam port, D, which receives the high-pressure exhaust steam coming, as shown above, by way of the intercepting valve into the rear end of the steam chest. In other words the high-pressure exhaust steam goes directly into the low-pressure cylinder and there continues its expansive force in acting on piston P, which moves forward in the opposite direction to piston O.

At this movement, the steam contained in the low-pressure cylinder, L, is being exhausted through the low-pressure steam port, D, into the exhaust passage, E, Fig. 3, directly in communication with the final exhaust passage, S, and thence into the atmosphere. It can now be readily understood that the valve, W, on its return or backward stroke, will uncover simultaneously high and low-pressure steam ports, A and D, respectively, and that the high-pressure cylinder, H, will exhaust through B into the forward part of the steam chest, by way of the intercepting valve, as explained before (see Fig. 3), and pass into the low-pressure cylinder through low-pressure steam port D; there it will continue to exert its expansive force on piston P, which will move in the opposite direction to the piston O, while the expanded steam in the low-pressure cylinder will exhaust through port C to the atmosphere as before.

Change From Compound Into Simple and Vice-versa.—This condition is brought about by a quarter turn of the intercepting valve I and in the following manner: Referring to Fig. 3, it will be clear that each half of the intercepting valve I forms a connecting passage between two similar ends of one high and one low pressure cylinder; that is, when the forward end of a high-pressure cylinder is being exhausted the forward end of the low-pressure cylinder—on the same side of the engine—receives that steam by way of that connecting passage. At that time the rear end of the high-pressure cylinder receives steam from the boiler and the rear end of the low-pressure cylinder exhausts into the atmosphere, as described above. If the intercepting valve, I, is given a quàrter turn its position will be like the one shown in Fig. 4, or the communication between the passages P and F is cut off; that is, the communication between two similar ends of one high and one low-pressure cylinder is cut off. But by the same movement of this intercepting valve and by way of this valve through passage F' and E', a communication is established between the high-pressure cylinder exhaust and the main exhaust passage, S. In other words, when the high and low-pressure cylinders do not communicate by way of the intercepting valve the high-pressure cylinder exhausts to the atmosphere. So does the low-pressure cylinder in the usual manner.

When the intercepting valve is turned into a position as shown in Fig. 4—that is, when operating all four cylinders simple expansion—live steam from the boiler is admitted into the front and rear ends of the steam chest. The pipes, Y^1, are tapped into the outer walls forming the passages of G, which lead into the ends of the steam chest, and by proper connections are carried to the dome of the boiler; the admission of steam into the steam chest by way of these connections is regulated and manipulated from the cab.

This arrangement permits of closing the throttle valve and thus cut out from operation the high-pressure cylinders and work the low-pressure cylinders alone on live steam from the boiler. This may be resorted to when a high-pressure cylinder head is blown out, or broken rod, axle, hot pin or journal gives trouble. The inside gear is then disconnected, the piston blocked, the intercepting valve turned into a position as in Fig. 4, live steam admitted from the boiler into the low-pressure cylinders and the engine can handle the train in spite of the accident. The reverse conditions hold when the outside cylinders are disconnected.

When starting the engine after a period of rest or when desirable to temporarily increase the tractive force of the engine, the engine is thrown into simple working, live steam is admitted to both high and low-pressure cylinders and the engine can be run for ten, fifteen or a hundred revolutions of the wheels without in any way disturbing the uniformity and normal running of the mechanism.

Locomotive practice on the Atchison, Topeka & Santa Fe is worth watching, because of the interesting and important developments which are working out on that road. In this issue a large engine with a novel boiler is described, and even greater departures from current practice are to come. A jump to nearly 6,000 sq. ft. of heating surface is suggested for new designs soon to be forthcoming, but thus far the details of the new engines have not been settled. The heavy locomotive is to be tried on this road on an unprecedented scale and without waiting for the growth to come as a transition. This is a substantial endorsement of the heavy engine, which is likely to exert an important influence on future practice.

OIL FUEL FOR LOCOMOTIVES.

Practice on the Pacific Çoast.

By H. B. Gregg, Engineer of Tests, Santa Fe Pacific Railway.

(Continued from page 386 of previous volume.)

Editorial Note.—It is well understood that practice in fuel oil burning has advanced to a stage which renders the selection of this fuel merely a question of the relative costs of coal and oil. For this reason, and because of the scarcity of data from which to make the comparison, this paper by Mr. Gregg is an important one. It should be emphasized that, thus far, oil has been burned in ordinary locomotive fireboxes, originally designed for coal and not specially favorable to oil. It is fair to expect better results with the new designs of oil burning fireboxes, in which the peculiarities of oil fuel will be studied and provided for. The corrugated cylindrical furnace seems to be especially adapted to this fuel, and the next step in this development is looked upon as a probable means for securing better results than have thus far been obtained. There can be no question of the advisability of designing furnaces specially for oil, in view of the recent developments in the oil fields of Texas, which should remove the hazard of building locomotives in which coal cannot be used.

OIL FUEL TESTS.

Santa Fe Pacific Railway.

Three tests are recorded. The first compares, in freight service, coal from Gallup, New Mexico, with oil from the Bakersfield district, as used in locomotives on the fifth district of the Santa Fé Pacific Railway between Needles and Bagdad, California. The second gives results of oil consumption in passenger and freight service on a mountain division, between San Bernardino and Barstow, and on a comparatively level division between Stockton and Bakersfield. The third compares Texas and California oils. The locomotives were in regular train service.

TEST NO. 1.—FREIGHT SERVICE.

Comparing Coal and Oil.

The engines selected were of the consolidation type, with 21 by 28-in. cylinders, 75-in. wheel centers, 68-in. boilers, weight on drivers 144,500 lbs., on truck 17,000 lbs., total engine 161,500 lbs. Steam pressure carried, 180 lbs. In one instance (engine 563), a 20 by 28-in. cylinder ten-wheeler was coupled with a consolidation engine for one trip. On all runs the engines were double-headed.

Before leaving Needles the engine tanks were coaled up and filled full of water and then weighed. At Bagdad, there being no scales, the coal left on the tank was estimated, the tanks were then coaled up from chutes and the coal chute weights taken. Upon the return to Needles the tanks were first filled with water and then weighed. The difference between the two scale weights, plus the coal-chute weights, gives the total amount used on the round trip. Usually the amount of coal left on the tanks, both at Bagdad and at Needles, was so small that it could be estimated fairly, in some instances the coal being entirely gone. The amount of coal charged to the engines each trip includes that used to fire up or to keep them hot while at terminals. Usually at Needles the engines had to be rekindled, while at Bagdad the engines were kept fired up.

The above is also true of the oil burners. The amount of oil charged to engines includes that used to fire up and to keep the engines hot while at terminals. The amount of oil used was found from the known capacity of the tanks on the engines. In estimating the "Tonnage Hauled" and "Car Mileage" the water car, carrying water for the engines, is counted one load, and its tonnage included. The way car is figured at 16 tons, but is not counted in the number of cars or the car mileage. Three empty cars are figured as equivalent to two loads. Under the column "Time on the road," is included the time between leaving and arriving at terminals. "Running time" includes only the actual time the train was in motion. "Delayed time" includes all time taken up for stops of any kind.

From the tests in road service it was found that between Needles and Bagdad the amount of coal burned in hauling 1,000 tons one mile is 356 lbs., and the amount of oil is 159 lbs., and to haul 1,000 loaded freight cars one mile the amounts are 11,946 lbs. of coal and 5,334 lbs. of oil.

These data are given in Tables 1 and 2. From Needles to Bagdad the distance is 91.7 miles.

consumed per 1,000 ton miles and per 1,000 car miles, is as follows:

Mountain Division.

Oil per 1,000 ton miles, through passenger service, west bound, 189 lbs.; east bound, 321 lbs.

Oil per 1,000 ton miles, freight service, west bound, 142 lbs.; east bound, 246 lbs.

Oil per 1,000 car miles, passenger service, west bound, 7,039 lbs.; east bound, 11,865 lbs.

TEST NO 1. TABLE NO. 1.

Fuel Oil Consumption Per Ton and Car Mile—Needles to Bagdad.

Date.	Eng. No.	Time on the road. H	M	Delayed time. H	M	Running time. H	M	No. stops.	Ave. speed M. P. H.	Ton miles.	Car miles.	Pounds fuel oil used. Pounds, each engine.	Total used.	Pounds, ton mile.	Pounds, car mile.
Freight—West Bound.															
4-16-01	713 465	10	21	4	45	5	36	8	16.36	93,982	2,840	6,670 7,138	13,808	.14692	4.862
4-20-01	713 723	10	50	4	23	6	27	8	14.20	101,676	3,115	9,093 9,093	18,186	.17886	5.838
4-22-01	713 723	9	28	3	44	5	44	7	15.97	109,920	3,298	10,003 9,942	19,945	.18145	6.048
4-24-01	713 723	7	15	2	29	4	46	7	19.21	107,722	2,840	6,820 8,032	14,852	.13787	5.229
4-25-01	713 723	13	25	8	6	5	19	13	17.23	97,096	3,298	10,533 11,745	22,278	.22944	6.755
Freight—East Bound.															
4-21-01	713 723	7	20	.	..	..	..	..	....	110,836	3,298	6,971 7,274	14,245	.12852	4.319
4-23-01	713 723	5	43	1	16	4	27	5	20.58	106.989	3,115	7,959 7,274	15,233	.14238	4.890
4-24-01	713 723	5	10	1	8	4	2	2	22.71	113,126	3,206	6,820 7,730	14,550	.12862	4.538
4-26-01	713 723	8	10	.	..	..	..	..	....	99,844	2,931	10,608 6,668	17,276	.17203	5.894

	West bound.	East bound.	West and east.
Total number ton miles made...........	510,396	430,795	941,191
Total number car miles made..........	15,391	12,550	27,941
Total pounds oil consumed...............	89,069	61,304	150,373
Ave. consumption of oil per ton mile..	0.17491	0.1423	0.1586
Ave. consumption of oil per car mile..	5.787	4.880	5.3335

TEST NO. 1. TABLE NO. 2.

Coal Consumption—Needles to Bagdad.

Date.	Eng. No.	Time on the road. H	M	Delayed time. H	M	Running time. H	M	No. stops.	Ave. speed M. P. H.	Ton miles.	Car miles.	Lbs. coal used. Total used.	Pounds, ton mile.	Pounds, car mile.
Freight—West Bound.														
4-11-01	653-685	11	18	4	22	6	56	7	13.21	109,920	3,389	43,100	.39210	12.7176
4-13-01	653-685	9	32	3	2	6	30	6	14.09	102,684	3,298	42,240	.41136	12.8077
4-17-01	643-675	13	12	7	34	5	38	7	16.26	110,470	2,840	33,590	.30406	11.8274
4-30-01	650-677	12	20	6	17	6	3	7	15.14	111,844	3,664	38,970	.34843	10.6359
5- 2-01	650-677	8	45	2	27	6	18	6	14.54	109,920	3,298	41,250	.37527	12.5076
Freight—East Bound.														
4-12-01	653-685	7	17	2	20	4	57	6	18.50	107,447	3,023	31,760	.29559	9.7449
4-14-01	653-685	10	39	2	36	8	3	5	11.37	118,164	3,298	44,250	.37448	13.4172
5- 1-01	650-677	10	48	4	3	6	45	8	13.57	141,064	3,939	42,200	.29915	10.7133
5- 3-01	650-677	9	42	2	25	7	17	5	15.30	108,322	3,617	45,400	.41912	12.5518

	West bound.	East bound.	West and east.
Total number ton miles made..........	544,838	474,997	1,019,835
Total number of car miles made......	16,489	13,877	30,366
Total pounds coal consumed............	199,150	163,610	362,760
Ave. consumption of coal per ton mile.	0.36552	0.34444	0.35574
Ave. consumption of coal per car mile.	12.07774	11.79001	11.9462

TEST NO. 2. TABLE NO. 3.

Fuel Oil Consumption Per Ton and Car-Mile on S. C. Ry. Between San Bernardino and Barstow.

Date.	Eng. Nos.	Train No.	Time on the road.	Delayed time.	Running time.	No. stops.	Av. M. P. M.	Ton-miles.	Car-miles.	Pounds oil.	Oil per ton-mile.	Oil per car-mile.
Passenger—West Bound.												
10-2	55	1	3.06	0.13	2.53	6	28.1	24,898	649	5,141	.20648	7.924
10-3	55	1	2.54	0.18	2.36	7	31.1	20,437	568	4,189	.20497	7.378
10-4	58	1	2.49	0.16	2.33	6	31.8	20,437	568	3,743	.18309	6.591
10-6	58	1	3.02	0.11	2.51	5	28.4	28,236	730	4,574	.16199	6.265
Passenger—East Bound.												
10-1	55-51	2	2.51	0.16	2.35	6	31.3	23,276	649	8,224	.35332	12.671
10-2	55-58	2	2.52	0.15	2.37	6	31.0	21,735	608	7,341	.33774	12.074
10-3	58-63	2	2.46	0.16	2.30	8	32.4	24,898	649	7,911	.31773	12.189
10-5	58-62	2	2.48	0.15	2.33	7	31.8	24,898	649	6,832	.27439	10.527
Freight—West Bound.												
9-28	246-51	33	9.18	4.43	4.35	8	17.7	84,425	2.595	11,313	.13400	4.360
9-29	246	33	8.19	2.51	5.28	7	14.8	72,415	2,510	9,348	.12909	3.724
10-8	62	33	6.25	1.57	4.28	5	18.1	37,549	1,180	5,624	.14977	4.766
10-10	57	33	7.03	2.05	4.58	8	16.3	39,354	1,407	5,795	.14725	4.115
10-12	138-92	33	7.20	1.41	5.39	7	14.3	77,311	2,427	11,607	.15013	4.782
Freight—East Bound.												
9-27	246 62-93	34	6.34	2.06	4.28	6	18.2	70,881	2,271	15,847	.22357	6.978
9-29	246 92-58	34	6.48	2.16	4.32	6	17.9	55,975	1,935	15,117	.27007	7.812
10-8	62-246	34	6.23	2.20	4.03	6	20.0	36,657	1,217	8,080	.22042	6.639
10-10	90 62-59	34	8.14	3.20	4.54	11	16.5	62,447	2,109	15,320	.24532	7.264
10-12	138 53-62	34	6.30	2.30	4.00	8	20.2	43,875	1,460	11,958	.27254	8.190
Average for passenger service west-bound.................											.18913	7.039
Average for passenger service east-bound.................											.32079	11.865
Average for passenger service west and east............											.25496	9.452
Average for freight service west-bound.....................											.14205	4.349
Average for freight service east-bound.....................											.24638	7.376
Average for freight service west and east.................											.19421	5.862

TEST NO. 2. TABLE NO. 4.

Fuel Oil Consumption Per Ton and Car-mile Between Stockton and Bakersfield.

Date.	Engine No.	Train No.	Time on the road.	Delayed time.	Running time.	No. of stops.	Av. m. per h.	Ton-miles.	Car-miles.	Pounds oil.	Oil per ton-mile.	Oil per car-mile.
Passenger—West Bound.												
10-22	201	1	7.41	1.16	5.25	28	40.2	71.438	1,806	10.031	.1404	5.554
10-25	205	5	7.26	1.20	6.06	21	42.3	39.008	897	7.064	.1811	7.875
Passenger—East Bound.												
10-23	201	2	7.58	1.08	6.50	29	37.7	71,438	1,806	10.611	.1485	5.875
10-26	208	6	8.15	1.08	7.07	21	36.2	39.008	897	7.368	.1889	8.214
Freight—West Bound. Bakersfield to Fresno, via Hanford.												
10-29	90	33	6.24	1.59	4.25	10	25.1	94.256	2,864	6.485	.06880	2.264
10-31	204	33	4.44	0.40	4.04	5	27.3	131.835	4,203	8.064	.06116	1.917
11-7	93	*	7.05	1.40	5.28	10	20.5	130.871	4,435	7.950	.06074	1.791
Freight—West Bound. Fresno to Stockton.												
10-31	204	33	5.17	0.56	4.21	4	28.2	143.411	4,432	8.073	.05629	1.822
11-16	93	33	6.25	1.09	5.16	5	23.3	141.319	4,555	7.450	.05272	1.635
Freight—East Bound. Stockton to Fresno.												
11-1	208	34	8.40	3.02	5.38	8	21.8	107.922	3,795	10.836	.10040	2.855
11-16	93	34	6.00	0.54	5.06	5	24.1	60.100	2,263	6.625	.11023	2.927
Freight—East Bound. Fresno to Bakersfield, via Hanford.												
10-30	103	34	5.38	1.10	4.28	11	24.8	87.374	2,654	7.130	.08160	2.686
11-8	91	34	6.58	1.55	5.03	10	22.0	67.954	2,355	8.283	.12189	3.517
Average for passenger service..............................											.1647	6.879
Average for freight service..................................											.07931	2.379

*Ex. W.

TEST NO. 2.—PASSENGER AND FREIGHT.

Mountain and Level Divisions.

Two statements, Tables 3 and 4, contain the records of this test. Table No. 3 is that of the mountain division between San Bernardino and Barstow, and No. 4 that between Stockton and Bakersfield, which is comparatively level.

From these two statements it is found that the amount of oil

Oil per 1,000 car miles, freight service, west bound, 4,349 lbs.; east bound, 7,376 lbs.

Level Division.

Oil per 1,000 ton miles, passenger service, east and west bound, 165 lbs.

Oil per 1,000 ton miles, freight service, east and west bound 79 lbs.

Oil per 1,000 car miles, passenger service, east and west bound, 6,879 lbs.

Oil per 1,000 car miles, freight service, east and west bound, 2,379 lbs.

TEST NO. 3.

Texas and California Oils Compared.

This comparison was made in passenger service between oil from Beaumont, Texas, and from Olinda, California. The engine selected had 18 by 24-in. cylinders and was of the eight-wheel type. In Table 5 the station names are necessarily abbreviated. The third column gives the run from San Bernardino to Los Angeles, via Loop and Pasadena; the fourth, from San Bernardino to Los Angeles, via Riverside and Orange; the fifth, Los Angeles to San Bernardino via Pasadena and Loop, and the sixth, from Los Angeles to San Bernardino, via Orange.

TEST NO. 3. TABLE NO. 5.

Summary of Results. Texas and California Oil Compared.

	Kind of oil.	San Brdo. to Los Ang. via Loop & Pas.	San Brdo. to Los. Ang. via Riverside and Orange.	Los Ang. to San Brdo. via Pas. & Loop.	Los Ang. to San Brdo. via Orange.	General average for all runs.	Grand total, all runs.
Pounds oil used on the road	Texas	3,506	3,291	3,888	2,735	....	33,081
	Cal.	3,573	3,620	3,705	2,592	....	33,149
Pounds oil used in roundhouse	Texas	440	440	440	440	....	4,400
	Cal.	440	440	440	440	....	4,400
Pounds oil, total	Texas	3,946	3,731	4,328	3,175	....	37,481
	Cal.	4,013	4,060	4,145	3,032	....	37,549
Lbs. per ton-mile, excl. amt. in r. h.	Texas	.31728	.29333	.34624	.40144	.33529	......
	Cal.	.32342	.29954	.35154	.38656	.33588	......
Lbs. per ton-mile, incl. amt. in r. h.	Texas	.35706	.33255	.38545	.46606	.37988	......
	Cal.	.36331	.33597	.39329	.45201	.38046	......
Lbs. per car-mile, excl. amt. in r. h.	Texas	9.6480	8.9429	10.7601	11.5401	10.1320	......
	Cal.	9.7455	8.7927	10.6465	10.9395	9.9278	......
Lbs. per car-mile, incl. amt. in r. h.	Texas	10.8585	10.1386	11.9787	13.3966	11.4796	......
	Cal.	10.9478	9.8619	11.9108	12.7918	11.2456	......
En. m. per ton oil, excl. amt. in r. h.	Texas	49.70	59.99	44.43	57.76	52.60	......
	Cal.	48.80	59.05	47.09	60.98	53.45	......
En. m. per ton oil, incl. amt. in r. h.	Texas	44.16	52.91	40.26	49.74	46.42	......
	Cal.	43.44	52.65	42.06	52.12	47.19	......
Lbs. water used, total	Texas	38,324	37,484	44,016	30,162	....	368,461
	Cal.	40,430	42,098	43,608	28,957	....	381,574
Lbs. water wasted	Texas	780	680	900	507	....	7,020
	Cal.	807	830	930	553	....	7,600
Lbs. water evaporated	Texas	37,544	36,304	43,116	29,656	....	361,441
	Cal.	39,624	42,268	42,678	28,404	....	373,974
Lbs. water evap. per lb. oil—actual	Texas	10.707	11.168	11.090	10.842	10.926	....
	Cal.	11.091	11.674	11.515	10.958	11.281	....
Lbs. water evap. per lb. oil, from and at 212 deg.	Texas	12.869	13.393	13.261	13.005	13.099	....
	Cal.	13.286	13.979	13.769	13.129	13.504	....
Ave. steam pressure	Tex.	159.8	159.2	159.	159.8	159.4	....
	Cal.	161.0	161.2	161.2	160.6	161.0	....
Ave. temp. of feed water	Texas	66.2	69.2	72.1	68.5	69.0	....
	Cal.	70.2	70.8	72.5	71.0	71.1	....
Ave. temp. of fuel oil	Texas	69.8	75.7	76.0	68.3	72.4	....
	Cal.	80.4	81.7	86.5	82.5	82.8	....
Av. speed in m. p. hr., deduct. stops	Texas	36.72	37.59	35.43	38.44	37.04	....
	Cal.	36.05	36.17	35.79	36.22	36.06	....
Engine mileage	Texas	87.1	98.7	87.1	78.9	....	870
	Cal.	87.1	106.9	87.1	78.9	....	886
Car mileage	Texas	365	368	361	237	....	3,265
	Cal.	368	413	348	237	....	3,339
Ton-miles	Texas	11,109	11,219	11,232	6,812	....	98,664
	Cal.	11,079	12,128	10,539	6,707	....	98,693

Ten trips were made over the same district with each kind of oil, except in two instances, due to a change in the time card, where the run was extended a distance of 4.1 miles. This accounts for a difference of 16 engine miles and 32 car miles in the total shown on the record.

The results show very little difference in the two oils, the amount of oil per ton mile being very nearly the same, at 0.380 lb. in both cases. The amount per car mile is 2 per cent., and the evaporation 3 per cent. in favor of the California oil, although the net gain in actual service is less on account of steam being used to heat the California oil in the tank. The Texas oil, being much thinner, does not require heating. From a comparative test made in the shop stationary boilers the same evaporation of 10.5 lbs. water per pound of oil—water at 65 degs. temperature steam at 85 lbs. pressure—was obtained.

The gravity of the Texas oil, as found by a Beaume gauge, was 21½, that of the California oil being 15½. Samples of each oil were weighed, and assuming water to weigh 8 1/3 lbs. to the gallon of 231 cub. ins., the Texas oil weighed 7.644 lbs. and the California oil 7.71 lbs. per gallon, which figures were used in these tests.

The amount of oil consumed while on the road or during the evaporation test, was found by noting the depth in the tank at starting the test, usually measured about 15 or 20 minutes before leaving time, and again at the end of the test, immediately after arrival at the terminal. From the scale of gallons per inch of the tank the pounds used were found. The amount of oil consumed while in the round house was found by subtracting the amount used on the road from the total issued. Because of the difference in the amount of oil used in the round house on the different runs, due to difference in length of layovers, it was thought more fair to divide the total amount equally for each trip, which accounts for the uniform figure of 440 lbs. The water consumption was found by noting the several depths of water in the tank at water stations, the initial and final water readings being taken at the same time as the oil readings were taken, and also when the water was at the same level in the boiler. The amount of water wasted is the amount lost at the injector overflow. A continuous counter, connected to the injector and operated by it, recorded the number of times the injector was operated, the amount wasted each time being found by working the injector a number of times and collecting and weighing the water so wasted, it being found to average 20 lbs. for each application.

In general, the steaming quality of the two oils was about the same, it being possible with either oil to keep a uniform pressure with one or both injectors on and with the engine making schedule time, and with very little smoke. The Texas oil was found to be a little more difficult to regulate, which is accounted for by a difference in the thickness of the oils, the Texas oil being very thin, and hence requiring a closer adjustment of the oil valve.

PERSONALS.

Mr. B. R. Moore, who has for several years held the position of chief draftsman in the motive-power department of the Chicago & Northwestern, has been appointed Mechanical Engineer of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters in St. Paul, Minn. He is succeeded on the Chicago & Northwestern by Mr. E. M. Prosser.

Col. Robert Andrews, Vice-President of the Safety Car Heating & Lighting Co., has been elected President of that company, vice Arthur W. Soper, deceased. This election was held Dec. 11, at a meeting of the Board of Directors, in the office of the Safety Car Heating & Lighting Co., 160 Broadway, New York. The vacancy in the Board of Directors was filled by the election of Mr. A. C. Soper, a brother of the late Arthur W. Soper. Colonel Andrews was in active railroad service for many years, and has many friends in railway circles He was born in Wilmington, Del., and his early education was received at the Episcopal Academy at Cheshire, Conn. He is also a graduate of Trinity College, at Hartford, and of the Polytechnic College in Philadelphia. His first position was that of Assistant Engineer of the State Canals of Pennsylvania, in which capacity he served from 1854 to 1857, when he was appointed Principal Assistant Engineer of the Sunbury & Erie R. R., and served that company for three years until 1860. From 1861 to 1864 he was staff officer in the army during the Civil War. From 1864 to 1865 he was Chief Engineer of the Saratoga & Hudson River R. R., and for 20 years, from 1865 to 1885 he served the Wabash Railroad as Division Superintendent, Chief Engineer and General Superintendent. From 1885 to 1888 he was General Superintendent and Engineer of the Virginia Midland R. R., and in 1889 was appointed Vice-President of the Safety Car Heating & Lighting Company and the Pintsch Compressing Company, which position he held up to his present appointment as President of the two last named companies.

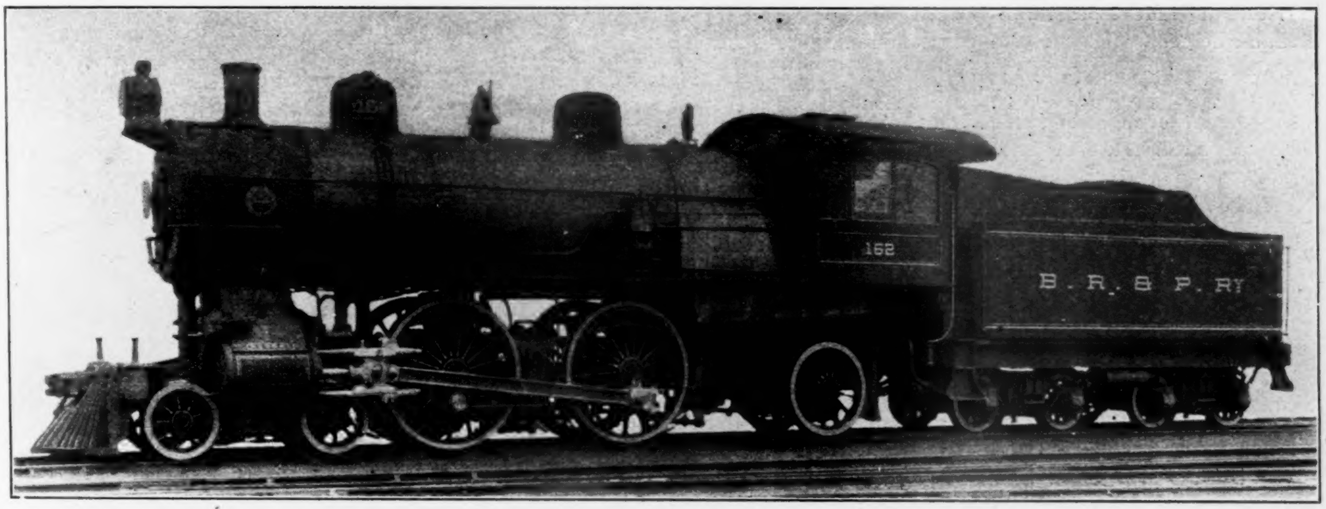
"CHAUTAUQUA" TYPE PASSENGER LOCOMOTIVES.

Buffalo, Rochester & Pittsburgh Railway.

Built by American Locomotive Company.

This description applies to two handsome passenger locomotives built last summer at the Brooks Works for the Buffalo, Rochester & Pittsburgh Railway for heavy passenger service.

In their general features these engines resemble previous designs of the same type, for the Burlington, Cedar Rapids & Northrn, and the Chicago, Rock Island & Pacific, but the B., R. & P. engines are much more powerful than their predecessors, having greater weight, more heating surface and higher boiler pressure than any of the earlier examples of this type. As to heating surface, this engine leads all of the Chautauqua type engines, even that of the Central Railroad of New Jersey, illustrated in this issue, although it has less total weight by 18,000 lbs. The B., R. & P. engines have 99,000 lbs. on their driving wheels, a weight which is seldom exceeded. The trailing wheels of these engines have radial boxes and are arranged like those of the Prairie type Lake Shore passenger engines, which were fully illustrated on page 74 of our March number, 1901.



"CHAUTAUQUA" TYPE PASSENGER LOCOMOTIVE—BUFFALO, ROCHESTER & PITTSBURGH RAILWAY.

C. E. Turner, *Superintendent of Motive Power.* American Locomotive Co., *Builders.*

The following table gives the leading dimensions:

General Dimensions.

Fuel	Bituminous coal
Weight on leading wheels	40,000 lbs.
Weight on driving wheels	99,000 lbs.
Weight on trailing wheels	34,000 lbs.
Weight, total	173,000 lbs.
Weight tender, loaded	120,000 lbs.
Wheel base, total of engine	20 ft. 2 ins.
Wheel base, driving	8 ft.
Height center of boiler above rail	9 ft. 7½ ins.
Heating surface, firebox	202.3 sq. ft.
Heating surface, tubes	2,805.6 sq. ft.
Heating surface, total	3,007.9 sq. ft.
Grate area	54.43 sq. ft.
Wheels, leading, diameter	33½ ins.
Wheels, driving, diameter	72 ins.
Wheels, trailing, diameter	51 ins.
Material of wheel centers	All cast steel
Type of leading wheels	Standard
Type of trailing wheels	Improved Radial Axle
Journal, leading axles	5½ by 12 ins.
Journal, leading axles, wheel fit	5½ ins.
Journal, driving axles	9½ by 12 ins.
Journal, driving axles, wheel fit	9¾ ins.
Journal, trailing axles	8 by 14 ins.
Journal, trailing axles, wheel fit	7⅞ ins.
Cylinder diameter	20¼ ins.
Cylinder stroke	26 ins.
Piston rod, diameter	3¾ ins.
Main rod, length center to center	139 ins.
Steam ports, length	25½ ins.
Steam ports, width	1⅞ ins.
Exhaust ports, least area	68 sq. in.
Bridge, width	3 ins.
Valves, kind of	11 ins. diameter, improved piston
Valves, greatest travel	5⅝ ins.
Valves, steam lap (inside)	1⅛ ins.
Lead in full gear	3/3 2in.
Boiler, type	Straight top
Boiler, working pressure	220 lbs. per sq. in.
Boiler, material in barrel	Steel
Boiler, thickness of material in shell	¾ in., 9/16 in., ½ in.
Boiler, thickness in tube sheet	¾ in.
Boiler, diameter of barrel front	70⅛ ins.
Boiler, diameter of barrel at throat	71⅝ ins.
Seams, horizontal	Sextuple
Seams, circumferential	Triple
Crown sheet stayed with	Radial stays
Dome, diameter inside	30 ins.
Firebox, type	Wide
Firebox, length	108 ins.
Firebox, width	74 ins.
Firebox, depth, front	73 ins.
Firebox, depth, back	64 ins.
Firebox, material	Steel
Firebox, thickness of sheets	Crown, ⅜ ins.; tube, ⅝ ins.; side, ⅜ ins.; back, ⅜ in.
Firebox, brick arch	On water tubes
Firebox, mud ring width	3½ ins. back, 3½ ins. sides, 4 ins. front
Firebox, water space at top	7 ins. back, 6 ins. sides, 4 ins. front
Grates	Rocking
Tubes, number of	336
Tubes, material	Charcoal iron
Tubes, outside diameter	2 ins.
Tubes, thickness	12 B. W. G.
Tubes, length over tube sheets	16 ft. ¼ in.
Smokebox, diameter outside	73 ins.
Smokebox, length from tube sheet	65 ins.
Exhaust nozzle	Single, permanent
Exhaust nozzle, diameter	5⅛ ins., 5 5/16 ins., 5½ ins.
Exhaust nozzle, distance of tip below center of boiler	6 ins.
Netting	Wire
Netting, size of mesh	2½ by 2½ No. 12 wire
Stack	Taper
Stack, least diameter taper	15 ins.
Stack, greatest diameter taper	16⅞ ins.
Stack, height above smokebox	27 ins.

Tender.

Tank, capacity for water	6,000 gals.
Tank, capacity for coal	10 tons
Type of under-frame	Steel channel
Type of trucks	B. L .W. all metal trucks
Type of springs	Triple elliptic
Diameter of wheels	33½ ins.
Type of draw-gear	B. L. W. twin spring

In 1900, $577,264,841 were disbursed in the United States in railroad wages; 4,916 of these workmen draw an average amount of $10.45 per day; 42,837 engine men draw wages averaging $3.75 per day.

Mr. R. P. C. Sanderson, recently appointed General Purchasing Agent of the Seaboard Air Line, has been transferred to the position of Superintendent of Motive Power. Mr. Sanderson was born in England in 1858, and after receiving his education in that country and in Germany he began his practical experience in connection with marine machinery. In 1882 he entered the service of the Norfolk & Western as draftsman, in connection with the construction of the Roanoke shops. From that time he filled motive-power positions successively, and in 1896 he was made Master Mechanic of the Eastern division of that road. In February, 1900, he was appointed Assistant Superintendent of Machinery of the Atchison, Topeka & Santa Fe.

PERFORMANCE OF LARGE ENGINES ON THE ILLINOIS CENTRAL RAILROAD.

An Analysis by a Motive Power Officer.

From the immediate and general attention given to the record of the tests of the large Illinois Central engines printed in our November number of last year, the performance of heavy locomotives appears to be an exceedingly important subject, and thoroughly worthy of the space we have given it. In the correspondence brought out by the printing of this record is a letter from a leading motive power officer, in which further analysis of these figures is given, and, by permission, it is printed nearly in full as follows:

The large engines are shown by these tests to be more economical than the light ones all through, under the circumstances of the tests, to a comparatively small extent, the total cost to haul 10,000 tons one mile being $1.86 for one of the large engines, as against $1.93 for the 10-wheel, and $2.02 for the mogul. This is a saving of 3½ and 7½ per cent. respectively. This saving is smaller than might have been expected, and some of the reasons for this are apparent upon investigating the figures. Other points which have affected the results are less clear and are indeed puzzling.

A fireman's helper was required on each of the large engines, which is, of course, one element tending to prevent a decrease in their cost of operation, but in spite of this additional expense for the large engines, the cost of enginemen's wages per 10,000 ton miles is about the same for all four engines. The cost of oil and waste and that of repairs is also about the same for all, on the ton-mile basis. The large engines cost 7 and 4 cents respectively more for coal per 10,000 ton miles, and they show an economy of about 15 and 19 cents for trainmen's wages, as compared with the others. In other words, the only apparent advantage to be gained by the use of such large power, entailing the employment of a fireman's helper, would be on account of the saving in the wages of trainmen, and even this is offset to a certain extent by the extra cost of fuel. This is the result on the face of the report, but a close examination of the figures would lead to an inquiry whether any broad assertion to that effect is justified by these tests. In the first place, the large engines do not appear to have been loaded to anything like their capacity; their tonnage rating over ruling grade is 1,800, their average train tonnage was 1,517 and 1,511, practically 84 per cent. of their rating, whereas the other engines pulled 102.5 per cent. and 117.4 per cent. of their ratings respectively. Without knowing the reason for this, it would appear that since the average cars per trip for the large engines were 49 and 50, that the trains were for transportation purposes limited to 50 cars; this is simply a guess, but if it is a fact, the mere loading of these engines up to their capacity would have made the figures very different, and the cost per 10,000 ton miles would then have been far more favorable to the large engines.

The large engines apparently required an excessive amount of repairs, not only in the cost in dollars and cents, but in the time they were held for repairs, 275 and 485 hours for the large engines as against 97 and 142 hours for the smaller ones. It would be interesting to know whether such repairs were liable to be continually required, or whether they were not to some extent owing to each of these engines being the first of its particular design and to a certain extent extraordinary. A slightly greater cost per engine mile would be expected, but on the ton-mile basis, if conditions were normal, a decrease in the cost for the large engines would be looked for, leading to a more favorable statement for them, even if the differences were unimportant.

The extra cost of coal on the large engines is peculiar, especially as their evaporative efficiency is higher than that of Nos. 35 and 489 by 6 per cent. and 7 per cent. The smaller engines show a higher average running speed, 20.24 and 19.05 miles per hour, against 17.71 and 17.95 miles, and in consequence have expended more power per ton mile, but this would be slightly compensated for by the longer standing time in service of the large engines. On the other hand, the evaporation of the large engines is 6.491 and 6.397 lbs. of water per pound of coal, as against 6.028 and 6.003 lbs. for the smaller, practically 6.4 lbs. against 6.0. There appears to be no reason shown for this difference, which might occur from several causes. The weight of the engine is apparently not included in the train loads, but it is closely proportional to the tonnage rating, not varying sufficiently to make a difference.

The grate area is less in proportion to the tonnage rating on the large engines, but is substantially the same in proportion to the average train tonnage. The heating surface in Nos. 639 and 640 bears about the same proportion to the average load as in No. 35, but is far greater than in No. 489; curiously the 489 shows just as good evaporation as the 35. The gallons of water used per running hour per square foot of heating surface, in other words, the rate of evaporation per square foot of heating surface, is the same or slightly greater for the 639 and 640 than for the 35, and is far greater for the 489. The coal per running hour per square foot of grate surface is about the same for all the engines. The ratio of average train tonnage to the tractive power varies considerably, and is very much lower in the large engines than in Nos. 35 and 489.

The figures referred to in the above statements are given in the table below; they are simply reproductions of those given in the report.

Engine No.	35 10-wheel.	489 Mogul.	639 Cons'dat'n.	640 12-wheel.
Grate area ÷ Average load	.0253	.0222	.0254	.0248
Heating surface ÷ Average load	2.23	1.45	2.11	2.33
Water per lb. coal	6.028	6.003	6.491	6.397
Galls. water per sq. ft. heating surface per hour	.717	1.090	.787	.715
Lbs. coal per sq. ft. grate per hour	84.0	87.6	84.1	88.1
Weight of engine % of gross tonnage per trip	12.1%	9.75%	10.1%	10.8%
$\frac{\text{Average train tonnage}}{Pd^2s \div D}$	.0336	.0389	.0259	.0258
Water per 10,000 ton miles	6,330	6,900	7,820	7,800

In general, the above figures show that although neither the rate of combustion or the rate of evaporation in the large engines differed appreciably from No. 35, yet they show an increased evaporative efficiency of about 7 per cent., while No. 489, with far less heating surface, shows up as well as No. 35; perhaps the boiler of No. 35 was scaled slightly. In spite of this advantage in evaporative efficiency, the coal per 10,000 ton miles is far greater for the large engines, owing to their greater consumption of water, 7,800 as against 6,330, and 6,900 gals. per 10,000 ton miles for Nos. 35 and 489. The only apparent explanation for this is the fact that the big engines were not loaded to capacity, or, perhaps, since their boilers were worked as hard as those of the smaller engines, it would be better to say that they were over-cylindered for their loads.

Whatever the cause may be this report is exceptional as showing a higher cost per ton mile for oil, waste, coal and repairs for large engines than for small. It is needless to remark that a change in the results in these items, even if simply equalizing them, would have made the large engine showing much better. Providing their boiler capacity would allow of it, and this is one of the most interesting questions raised by the report, if Nos. 639 and 640 could have been loaded to capacity, even at the same cost per ton mile for fuel, oil and repairs, the saving in the salary account would have shown them to be economical to the extent of about 15 per cent. instead of 5 per cent., a gain well worth careful notice.

THE JUNE CONVENTIONS.

Saratoga has been decided upon for the conventions of the Master Car Builders' and Master Mechanics' associations for next June. The former will open its first session June 18 and the latter June 23. The headquarters will be at the Grand Union Hotel.

NEW DESIGN OF PLAIN MILLING MACHINE.

The Brown & Sharpe Manufacturing Company has recently placed upon the market a new design of plain milling machine, built for work requiring unusually large table capacity and long cuts. It is provided with very heavy gearing, which especially adapts this machine to the requirements of machine tool builders, engine and railroad shops and in general for the heavier class of milling.

In this design special care has been taken to make the machine as convenient to operate as possible. This is shown in the accompanying engraving. All the working parts are easy of access, and all levers and hand wheels are so placed that the operator has easy control of the various movements of the machine. A wide range of feed changes are obtained by means of transposing gears. With two speeds of the countershaft eight changes of speed are obtained, varying from 15 to 100 revolutions per minute. The advantages of this method of driving are readily appreciated, as the speed of the spindle

New Design of Plain Milling Machine.
Brown & Sharpe Manufacturing Company.

cone is maintained more uniformly than when the changes of speed are wholly dependent upon the number of steps on the cone, and the power is not reduced to such an extent when slow speeds are required for heavy cuts.

The steel spindle has ground and lapped bearings and runs in phosphor bronze boxes provided with means of compensation for wear. A phosphor bronze worm-wheel and worm of steel, hardened, are used to drive the spindle. They are run in oil, and the thrust of the worm is taken by ball bearings. The spindle cone runs idle and in the same direction as the shaft on which it is mounted, thus reducing the friction to a minimum. It has only two steps, the power being transmitted through a system of gearing arranged to give an exceptionally high ratio. An improvement has been made in the method of clamping the spindle head and knee, each being clamped by one lever in place of two as formerly. The arm support is exceptionally rigid and of improved design. It is made in two parts, clamped directly to the front of the knee and can be easily placed in position or removed. The two parts slide upon each other and are clamped in position by bolts passing through the slots. This form admits of a bearing for the outer end of the arbor directly in the support, and allows the adjustable arbor support to be used at any intermediate point on the arbor, thus giving the arbor an exceptionally rigid support. The table has a working surface 72 by 17¼ ins., and can be lowered 19 ins. from the center of the spindle. It is supported directly in the knee, which is exceptionally long for the capacity of the machine. An important feature of the table is that it remains locked in position when the feed is automatically thrown out. A dial, graduated to read 64ths of an inch, indicates the transverse movement of the head of the machine, while adjustable dials, graduated to read to thousandths of an inch, indicate the longitudinal, transverse and vertical movements of the table.

The important feature of this milling machine is its simplicity. This was the object in securing as direct a transmission of power as possible, and at the same time provide for a wide range of feed changes. It is apparent that a drive of this character by chain and sprocket wheels insure a positive and uniform feed for the table.

ARTHUR W. SOPER.

Arthur W. Soper, President of the Safety Car Heating & Lighting Company, and of the Pintsch Compressing Company, died at his home in New York, December 1, after a short illness. He was forceful, energetic and successful, first as a railroad officer, and afterward in the conduct of large business affairs, but combined with business ability, sagacity, perseverance, and all that goes to make success, he had sincerely friendly attributes which always brought a ready response to the needs of others. His death will be mourned by many who knew him well, and others whom he had befriended. In railroad service he spent thirteen years with the Rome, Watertown & Ogdensburg, leaving that road in 1881 as Assistant Superintendent, to take a similar position on the St. Louis, Iron Mountain & Southern. He remained with that road ten years, the last three years of which he was General Manager. In business he was equally successful, the general introduction of the Pintsch system of car lighting being largely due to his leadership. Besides this he had other important interests, being a director in the Wheeling & Lake Erie Railroad, the Standard Coupler Company and other industrial concerns. He was also deeply interested in the application of compressed air to traction problems. He was a typical example of the class of men who have made American railroads what they are.

Mr. George Gibbs, Consulting Engineer of the Baldwin Locomotive Works and the Westinghouse Electric and Manufacturing Company, has been appointed Consulting Engineer for the Rapid Transit Subway Company of New York. He will have charge of all of the essentially railroad problems, including the construction of the tracks, cars and signals, and the plans for the operation of the road, including schedules and all operating problems. This is a fortunate selection, because of the experience of Mr. Gibbs in railway service and his subsequent research in connection with the application of electricity to traction. The consulting board for this work is admirably selected, each member being a specialist of recognized ability and standing. The appointment of Mr. Gibbs brings the only distinctive railroad experience represented, and a wiser selection could not be made.

The most extensively equipped electric railway, for freight business, in this country, is that of the St. Louis & Illinois Suburban Railway. Its equipment for handling freight consists of four 50-ton locomotives, each equipped with four 160 h.p. motors, and 400 coal cars of 80,000 lbs. capacity. Six hundred more cars of similar capacity are to be added. This company operates two coal mines, using current from the trolley wires, and will soon open more mines.

BOOKS AND PAMPHLETS.

Calumet "K.," by Merwin Webster, author of "The Short Line War," etc., with illustrations by Harry C. Edwards. Published by Macmillan Company, 66 Fifth avenue. $1.50.

This story of the building of an enormous grain elevator in an incredibly short time pictures vividly, in the hero, Charlie Bannon, a typical Western "hustler." The ingenious manner in which he overcomes the many difficulties thrown in his way by railway men, business rivals, and "walking delegates" is truly fascinating. Bannon's skilful and successful handling of his large force of workingmen is well described; and the way in which he meets the labor union problem and avoids strikes and other difficulties is worthy of attention. The illustrations and excellent form of the book add much to its attractiveness.

The Indicator Handbook, a Practical Manual for Engineers. Part II., The Indicator Diagram, its Analysis and Calculation. By Charles N. Pickworth, Editor "The Mechanical World." Published by D. Van Nostrand Co., 27 Warren street, New York. Price, $1.50.

This little book of 132 pages supplements Vol. I. by the same author, which described the construction and application of the indicator. The present volume is devoted to the analysis of the indicator diagram and to horse-power calculations. An introductory chapter discusses elementary principles. This is followed by an examination of the diagram in detail and a study of the action of steam in the cylinder. Defective valve gear and its effects on steam distribution follow and then the compound diagram and methods of combining them are taken up. Indicator work in connection with internal combustion engines is treated quite fully, also air compressor and pump cards. Diagram calculations occupy the closing chapter. The use of small sized engravings is commendable; these are quite clear and satisfactory. On page 48 is given a table of results which follow an increase of outside and inside lap, angular advance and valve travel. This will be a convenience to refresh one's memory in valve motion questions. On page 122 the author describes a convenient slide rule horse-power computer for steam, gas and oil engines. This appears to be an excellent labor-saving device. These two volumes constitute the best work on the indicator and indicator diagram that we have seen.

A new book on Small Tools, Standards and Gauges has just been published by the Pratt & Whitney Company. This catalogue of 152 pages, 4¾ by 7¼ ins., is in every way a very creditable one. It treats of taps and dies, die stock sets for bolt and pipe threading, milling cutters, slitting saws, Renshaw ratchet drills, lathe tools, tapping heads, boiler punches, reamers, taper pins and all standard measuring machines, standard size and thread gauges, and gauges for special purposes. The book is neatly printed, with complete index. Those who are interested in this volume may secure a copy by writing to Pratt & Whitney Company, Hartford, Conn.

The advantages of systematic reading of current engineering periodicals, with an argument for the individual card index, forms the basis of a well-directed address by Prof. H. Wade Hibbard, before the student's Society of Mechanical Engineers of Sibley College. The paper lays stress on the importance of technical literature, the selection of a technical paper and how to use it; also the making of a card index. This address has been printed and put in pamphlet form, and to those interested in the subject a copy will be sent upon application to Prof. Hibbard, Sibley College, Ithaca, N. Y.

American Mines Annual. Comprising a careful, accurate and concise compilation of the active gold, silver, copper, lead and zinc mining and milling companies throughout the United States. By George E. Vigouroux, LL.B. Published by Geo. E. Vigouroux & Co., 1278 Broadway, New York. 1901. Price, $5.00.

This is a directory giving the names of companies engaged in the mining industry and profession, also the location of each company, its president, secretary, capitalization and par value of stock; its main business address, the type of reduction plant, together with the name of the manager or superintendent. The book is accurately arranged in so far as a book of this kind can be. It is the first edition of this directory, which promises to be an annual production.

EQUIPMENT AND MANUFACTURING NOTES.

S. E. Moore, the well-known accountant, for many years auditor of the Carnegie Steel Company, has been appointed auditor of the Pressed Steel Car Company.

The large increases in the business of the Handy Car Equipment Company have made it necessary for them to remove their office from 1525 Old Colony Bldg., to more extensive quarters in suite 890 of the same building. This company manufactures the Handy Box Car, and the Snow Car and Locomotive Replacers.

The new plant of the Buckeye Malleable Iron & Coupler Company, at the foot of Parsons street, Columbus, O., is being pushed rapidly toward completion. Both plant and equipment are to be up to date in every detail and nothing seems to have been forgotten or omitted which can tend toward making it so. Thirty-five acres of ground are provided. The plant includes two foundries of 1,000 ft. each, a boiler house, gas house, laboratory, store and shipping rooms. Shipping facilities are exceptionally good, as the works are reached directly by the Hocking Valley and the Toledo & Ohio Central railroads, with the Norfolk & Western near by. This new plant is the largest of its kind in Columbus and one of the largest in the country. It is located near the works of the National Steel and the Columbus Iron & Steel companies.

In the annual report of the Wheeling & Lake Erie Railroad, issued recently, President Joseph Ramsey says the traffic demands on the company greatly exceed the facilities for transportation. This condition of affairs has become aggravated since the Wheeling & Lake Erie was absorbed by the Wabash system. President Ramsey says: "We must at once arrange for at least 2,000 or 2,500 40-ton coal cars and about 25 freight locomotives, to be paid for under an equipment mortgage running 20 years with proper sinking fund provisions. Extensive work of improvement must be spread over several years, as it must be paid for out of the surplus earnings and must be limited each year to the amount available from that source. The Wheeling & Lake Erie is surrounded by railroads owned and operated by the wealthiest and strongest companies in the country, and it must be prepared to carry traffic at as low a cost per ton as any other road, or it must go to the wall."

Among the more recent and important orders received by the Triumph Electric Company, of Cincinnati, O., are the following: For the Krell French Piano Company an entire electrical equipment has been contracted for the factory, consisting of a 250-k.w. generator and 57 motors of various sizes from 1 to 40 h.p. The Globe-Wernicke Company has ordered a 200-k.w. direct-connected generator, five 30-h.p. motors, three 65-h.p. motors, two 20-h.p. motors, and two 10-h.p. motors. This is in addition to their present plant, which already has two generators of 200 k.w. each and motors aggregating 500 h.p. The Commercial Tribune Company, of Cincinnati, O., has also ordered one 200 and one 100-k.w. direct-connected generators. The steady increase in the business of the Triumph Electric Company has made it necessary to operate their factory 24 hours a day with two different shifts of men.

When Joseph Ramsey, Jr., the newly-elected President of the Wabash Railroad, was Superintendent of the Pittsburg Southern, a small road in the coal district, Mr. Joseph Walton, a millionaire coal miner of Pittsburgh, heard of his ability and decided that Ramsey would be just the man to take charge of a road which he was then projecting. Walton went over to the small town where Ramsey made his headquarters, in order to offer him the position. At the office he was told that Mr. Ramsey was out somewhere in the yards, so the "coal king" went out to look for him. The first man he came across was a grimy mechanic who was at work underneath an engine. "Where's Mr. Ramsey?" inquired Mr. Walton. "I'm Ramsey," replied the man, and then, climbing out from under the locomotive, he explained, laughingly, that there was "something wrong with the engine, and as the engineer didn't know how to fix it, I took a hand at it myself." That made Walton desire Ramsey's services more than ever, and indirectly was the cause of Ramsey's rapid advancement.